Appendix H

Part 1

DECLARATION FOR THE NEAL'S LANDFILL RECORD OF DECISION AMENDMENT

SITE NAME AND LOCATION

The Neal's Landfill site is located in Bloomington, Indiana. The National Superfund Database identification number is IND980614556. This Record of Decision (ROD) Amendment addresses contaminated water and sediment, and in this ROD Amendment are referred to as Operable Unit 2 and Operable Unit 3, respectively.

STATEMENT AND BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Neal's Landfill site, located in Bloomington, Indiana. This ROD amendment presents the remedial action selected in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and Section 300.435(c)(2)(ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This ROD Amendment will become part of the Administrative Record file per Section 300.825(a)(2) of the NCP. The Administrative Record which contains the information on which selection of the remedial action was based, is available for review at the Monroe County Public Library in Bloomington, Indiana, as well as at the United States Environmental Protection Agency, Region 5, Superfund Records Center.

ASSESSMENT OF SITE

The response actions selected in the ROD amendment are necessary to protect the public health or welfare or the environment from actual or threatened release of hazardous substances into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy for the Neal's Landfill site addresses groundwater and sediment contaminated by PCBs from springs on the Neal's Landfill site. The source control operable unit (operable unit 1) was completed in 1999 and addressed the principle threat waste through the excavation and off-site disposal and off-site incineration of high concentrations of PCB waste, including capacitors containing PCBs. The Selected Remedy consists of improving the spring water collection system and performing a sediment cleanup in Conard's Branch. The major components of the groundwater and sediment operable units consist of the following:

- Improvement of the spring water collection system to capture PCB-contaminated groundwater seeps which currently bypass the current collection system.
- Install a new effluent line farther downstream in Conard's Branch for discharging water treated by the water treatment plant. This will prevent treated water from being collected by the new spring water collection system.

- Continue to operate the 450 gallons per minute (gpm) water treatment plant, which is capable of treating up to 500 gpm. The water treatment plant will meet a revised PCB effluent standard of 0.3 parts per billion (ppb). A revised Operation and Maintenance Plan will also be implemented for the water treatment plant.
- Implement a soil and sediment cleanup for in-stream sediments, bank soils and floodplain soils in Conard's Branch. The cleanup criteria is 1 parts per million (ppm) on average for PCBs located in-stream sediments and bank soils and 5 ppm on average for floodplain soils. The estimated volume of contaminated soils and sediment is 1,141 cubic yards and this material will be disposed of off-site in a permitted landfill. The improvements to the spring water collection system for the 450 gallons per minute treatment plant and the sediment and soils cleanup are expected to reduce the PCB levels in fish tissue to acceptable levels within 10 years, based upon a fate and transport model.
- Implement institutional controls to prevent residential and commercial development for the 10-acre landfill cap, prevent residential development in the southeast portion of the site, prevent residential development and certain farming activities within the floodplain area of Conard's Branch and prevent groundwater use on the site.

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The remedy for the groundwater operable unit satisfies the statutory preference for treatment as a principal element of the remedy. Treatment is not employed for the sediment operable unit, but the remedy is consistent with other soil/sediment cleanups completed in Bloomington and the surrounding area.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure and it will take more than five years to attain remedial action objectives and cleanup levels, a policy review will be conducted within five years of construction completion for the site to ensure that the remedy is, or will be protective of human health and the environment.

RECORD OF DECISION AMENDMENT DATA CERTIFICATION CHECKLIST

The following information is included in the Decision summary section of the Record of Decision Amendment. Additional information can be found in the Administrative Record located at the Monroe County Public Library.

- Chemicals of concern and their respective concentrations are located on Pages 9, 10, 14, and 16.
- Baseline risks represented by the chemicals of concern are located on Pages 11 through 19.
- Cleanup levels established for chemicals of concern and the basis for these levels are located on Pages 19 and 20.

- Description of how source materials constituting principal threats are addressed is addressed on Page 40.
- Description of the current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD Amendment are located on Page 11.
- Description of the potential land and groundwater use that will be available at the site as a result of the implementation of the low flow collection system and sediment and soils cleanup is located on Page 35.
- Description of the estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected is located in Table 9.
- Description of the key factors that led to selecting the remedy is located on Page 40 and 41.

AUTHORIZING SIGNATURES AND SUPPORT AGENCY ACCEPTANCE OF REMEDY

The United States Environmental Protection Agency is the lead Agency for developing and preparing this Record of Decision Amendment. The State of Indiana, City of Bloomington, and Monroe County are signatories to the Consent Decree and those parties have all submitted letters of concurrence for the implementation of the above referenced alternative.

______________________________ 9-25-07

Richard C. Karl, Director
Superfund Division

Date

RECORD OF DECISION AMENDMENT
NEAL'S LANDFILL
OPERABLE UNITS 2 AND 3

SITE NAME, LOCATION, AND BRIEF DESCRIPTION

CBS Corporation (formerly known as Westinghouse Electric Corporation and Viacom Inc.) owned and operated a capacitor production facility in the City of Bloomington, Indiana. The insulating fluid used in the manufacture of the capacitors contained a polychlorinated biphenyl (PCB) dielectric fluid. PCBs are mixtures of up to 209 individual chlorinated compounds called congeners. Many commercial PCB mixtures are known in the United States as Aroclors.

Neal's Landfill began operation in 1950. Municipal and industrial wastes were deposited at the landfill until 1972. The landfill was originally known as Whitehall Pike Landfill and was later renamed Neal's Landfill after a former owner and operator. Municipal waste was the main type of refuse deposited at the landfill. Between 1958 and 1965, the landfill was expanded into topographic low areas adjacent to a central east-west oriented ridge. During 1966 and 1967, scrap and off-specification electrical capacitors from the Westinghouse plant in Bloomington were disposed of at the landfill along with PCB-contaminated capacitor parts, filter aids, and sawdust resulting in the release of PCB-contaminated dielectric fluids. The total volume of landfill material was approximately 320,000 cubic yards based on landfill borings completed in the 1980s.

Neal's Landfill is located approximately five miles due west of the City of Bloomington, Monroe County, Indiana (see Figure 1). The site consisted of approximately 18 acres that were used as an open dump and landfill on a larger property owned by a number of various parties. The most recent owner has passed away and the property, including the landfill, was bequeathed to the Sycamore Land Trust. The Sycamore Land Trust is currently determining if it is going to accept the property. State Route 48 is located approximately 800 feet directly south of the site. Access to the landfill is restricted by a security fence and private drive south from Vernal Pike.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Neal's Landfill was placed on the National Priorities List (NPL) in October 1981 and is one of the six sites addressed under the terms of a Consent Decree (CD) entered by the United States District Court for the Southern District of Indiana on August 22, 1985. The parties to the Consent Decree include the United States Environmental Protection Agency (U.S. EPA), Indiana Department of Environmental Management (IDEM), City of Bloomington, Monroe County, and CBS Corporation. The Consent Decree called for the construction of a permitted, Toxic Substances Control Act (TSCA) approved, dedicated, municipal solid waste-fired incinerator to be used to destroy PCB-contaminated soils and materials excavated from the six sites.

Public opposition to the incinerator arose before and after entry of the Consent Decree. CBS submitted applications for the necessary permits to design and build the incinerator in 1991. The Indiana State Legislature, however, passed several laws which prevented any immediate consideration of CBS's permit application. In February 1994, the parties settled upon a set of principles to guide the process of exploring alternative remedies. These principles, known as the Operating Principles, provided, among other things, that the selection of remedial alternatives would be conducted in accordance with the U.S. EPA Record of Decision (ROD) Amendment process. The Operating Principles are available for review in the Administrative Record located at the Monroe County Public Library.

In November 1997, Judge S. Hugh Dillin issued an Order requiring that the six Consent Decree sites be remediated by December 1999. Judge Dillin also assigned Special Master Kennard Foster to oversee the progress of the parties toward meeting the December 1999 deadline. On February 1, 1999, Judge Dillin issued another Order approving and adopting the Report and Recommendations of Special Master Kennard Foster which (1) extended the deadline for completion of the source control at the remaining five sites until December 31, 2000, and (2) ordered the parties to engage in settlement discussions with respect to other issues, including remedial measures to address groundwater and surface water contamination. The source control remedies were completed by the December 31, 2000 deadline, and CBS and the governmental parties are in the process of negotiating a global settlement[1] for all of the remaining issues regarding the six Consent Decree sites.

Investigations for contamination at Neal's Landfill began as early as 1976. Extensive sampling and initial site cleanup activities began in 1983. The 1983 initial site remedial measures were implemented in two phases pursuant to a Stipulation and Order. In the first phase, a security fence was installed around the entire perimeter of the site. Visible capacitors and associated stained soils were removed. A low-permeability clay cap was placed over the primary fill areas. Drainage control features and erosion control measures were installed. This action removed visibly identifiable areas of concentrated contaminants on the surface of the landfill. Sediment sampling was also performed in Conard's Branch, Southwest Seep Branch, and Richland Creek (see Figure 2). These activities were completed in May of 1984.

The second phase of the interim remedial measures was completed under the terms of the 1985 Consent Decree. Sediments were removed from a 4,500-linear-foot length of Conard's Branch and 300 linear feet of Richland Creek. The sediment cleanup was completed in October 1988 and approximately 5,000 tons of stream bed sediments and stream bank material were excavated and temporarily stored at an interim storage facility until they were disposed of at an approved landfill in 1998. CBS constructed a water treatment plant to collect water up to 1 cubic foot per second (cfs) from South Spring, North Spring and the Southwest Seep. Based upon data acquired from the treatment plant, the facility is designed for 450 gallons per minute (gpm) capacity, but often treats

[1] The global settlement will include both technical and non-technical issues.

as much as 500 gpm. In the Consent Decree, the discharge criterion for the water treatment plant was set to 1 part per billion (ppb) PCBs. The treatment plant became operational in February 1990.

The final remedy for the site memorialized in the 1985 Consent Decree was never implemented by CBS. After the parties agreed in February of 1994 to explore alternatives to the remedy set forth in the 1985 Consent Decree, U.S. EPA and CBS undertook a new, detailed investigation of the site. Based upon this re-investigation, U.S. EPA issued a Proposed Plan for the source control operable unit of the alternative remedy on December 21, 1998, and held a 45-day public comment period. The other governmental parties, including IDEM, City of Bloomington, and Monroe County concurred on the ROD Amendment. The ROD Amendment was signed on March 29, 1999.

The source control operable unit remediation involved the following:

- Excavation and disposal of 41,747 tons of PCB-contaminated material greater than or equal to 50 parts per million (ppm) to Environmental Quality Company's Wayne Disposal Landfill, in Belleville, Michigan.

- Excavation and transport of a total of 4,119 capacitors contaminated with PCBs to Onyx Environmental in Port Arthur, Texas, for incineration.

- Shrinking the size of the landfill from 18-acres to 10-acres through the consolidation of landfill material.

- Collection, shredding, and disposal of 28,881 tires under the final Neal's Landfill cap.

- Installation of a Resource Conservation Recovery Act (RCRA) Subtitle C-compliant cap over the remaining landfill material. The cap consists of six inches of topsoil, 18-inches of clean granular fill, a geocomposite drainage layer, a 40-millimeter thick geomembrane, and a geosynthetic clay layer.

- Construction of perimeter drainage and a stormwater retention pond.

- Installation of 5 piezometers into the bottom of the landfill waste to monitor accumulation of any groundwater.

- Clean up of areas outside the landfill boundary.

- Implementation of Long-term Groundwater Monitoring and RCRA Cap Inspection and Maintenance Plans.

- Development and implementation of institutional controls.

The Neal's Landfill RCRA Cap Inspection and Maintenance Plan was approved in April 2001. The following activities are performed by CBS pursuant to the approved plan:

- Routine quarterly inspections of the landfill cap for damage.
- Mowing.
- Annual application of herbicide at the fence lines and rip-rap drainage ways.
- Biennial topographic survey and subsidence report.

The continuing release of PCBs and other hazardous constituents from springs connected to the Neal's Landfill and the subsequent contamination of soils and sediment from the releases from these springs requires the need for two additional operable units, which are set forth in this ROD Amendment.

COMMUNITY PARTICIPATION

The community has been involved at the Neal's Landfill site. The U.S. EPA provided a Technical Assistance Grant (TAG) to a citizens group called Citizens Opposed to PCB Ash (COPA). In addition to hiring experts to review documents, COPA has used this grant to develop an Internet web page (www.copa.org) to distribute information to the public. The U.S. EPA and IDEM have participated in, at minimum, quarterly Citizens Information Committee meetings with the public to update them on recent site activities. These meetings are shown on the local Bloomington cable access station.

The Proposed Plan for the water treatment operable unit (OU 2) and sediment operable unit (OU 3) for the Neal's Landfill site was made available to the public for 30 days on July 6, 2007. A 30-day extension of the public comment period was provided at the start of the comment period. Additional days were added to the public comment period taking into consideration the amount of time elapsed before certain documents missing from the Administrative Record (AR) were added. The public comment period for the Proposed Plan ended on September 17, 2007, for a total of 74 days of public comment. The AR in electronic form was placed in the Monroe County Public Library. Interested parties were able to receive copies of the AR for review and for the development of comments on the Proposed Plan for OU 2 and OU 3. Approximately 6,000 OU 2 and OU 3 Proposed Plan postcards were mailed to residents in the Bloomington area and an Internet link was provided to a fact sheet for review.

A public meeting was held on August 7, 2007, to present the Proposed Plan for OU 2 and OU 3 to the public and a transcript of that meeting was prepared. Representatives from U.S. EPA and the State of Indiana were present to answer questions. U.S. EPA's response to comments received during the public comment period is included in the Responsiveness Summary, which is part of this Record of Decision Amendment for Operable Units 2 and 3.

SCOPE AND ROLE OF THE OPERABLE UNITS

This action is the final action for the Neal's Landfill site and addresses both contaminated groundwater and sediment, known respectively as Operable Units 2 and 3. The 1999 ROD Amendment provided for source control by addressing the principal threat waste through excavation and by disposing of PCB-contaminated material off-site in a chemical waste landfill and incinerating PCB capacitors filled with PCB-contaminated oil off-site at a permitted facility. The remaining landfill material was consolidated and capped with a RCRA Subtitle C compliant cap. These final two operable units are intended to prevent current and future exposure to contaminated media through treatment of groundwater and removal of contaminated sediment. The treatment of groundwater in this response is intended to permanently reduce the toxicity, mobility, and volume of the releases of PCBs into Conard's Branch and Richland Creek, thereby protecting individuals who might swim or fish in these streams as well as protect animals that might feed in and along them.

SITE CHARACTERISTICS

A large number of groundwater and sediment investigations have been conducted at Neal's Landfill since the early 1980s. Many of these investigations uniquely pertain to the groundwater flow in a karst system. Karst terrain is a landscape produced through the interaction of slightly acidic rainwater with soluble limestone bedrock. This process known as dissolution forms a variety of landscape features, including sinkholes, subterranean voids, solution conduits, caves, and springs. Drainage in the Neal's Landfill area is predominantly subterranean through the karst features. The drainage is characterized by rapid groundwater flow from sinkholes through a branchwork of subterranean solution conduits and caves to discharge points at springs. Contaminants in karst groundwater may move rapidly through the drainage network to springs located miles from the source area without the benefit of normal attenuation processes. The following is a partial list of investigations:

- Geophysical surveys to understand the site geology including magnetometry, topographic analysis, air photo analysis, seismic refraction, ground penetrating radar, borehole geophysics, frequency domain magnetics, and equipotential direct current resistivity survey.

- Installation of over 20 monitoring wells to evaluate groundwater conditions.

- Well video logging.

- A residential well survey and two residential well sampling events in 1986 and 1999.

- Development and implementation of a groundwater monitoring plan including the sampling of wells, springs and nearby streams.

- Low flow and high flow on-site and off-site dye tracer tests to determine groundwater flow pathways and delineate groundwater drainage basins.
- Continuous and periodic water level monitoring in wells and piezometers to determine groundwater elevations.
- Continuous and periodic surface water flow measurements in springs and streams.
- Direct investigation of the subsurface karst drainage system through cave entry, exploration, and survey.
- Investigation to discover groundwater conduits upgradient of the landfill through geophysical methods, drilling, and excavation of sinkholes.
- Analysis and development of a discharge capture model to evaluate flow and PCB mass released.
- Treatability studies to evaluate the settling of PCBs in Conard's Branch during storm flow conditions.
- Development of a fate and transport model using hydrodynamics, sediment transport, PCB fate and transport and PCB bioaccumulation to assist in evaluating remedial alternatives.
- Sediment sampling, stream bank sampling, and floodplain sampling in Conard's Branch and Richland Creek.
- Fish tissue sampling in Conard's Branch and Richland Creek and analysis using PCB Aroclor and congener analytical methods.

Site Geology and Hydrogeology

The Neal's Landfill site is situated on a topographic saddle that overlies a watershed divide on an east-west oriented ridge. Natural surface drainage is generally to the north and west into tributaries of Richland Creek. The northern tributary, known as Conard's Branch, drains the northern portion of the landfill and flows into Richland Creek 4,800 feet northwest of the site. The west-flowing tributary, referred to as Taylor Branch, drains the southern portion of the landfill and flows into Richland Creek about 6,000 feet west of the site. Headwater portions of Taylor Branch extended through the southeast portion of the landfill. During early operation of the landfill, these valley areas were filled in to a depth of about 20 to 25 feet. Surface drainage was impeded and ponded behind the waste in an area referred to as the "Cattail Pond." Water from a seep known as the Southwest Seep was captured and treated by the water treatment plant. After the source control operable unit was completed and the site drainage was modified, the Southwest Seep dried up and is no longer being treated by the treatment plant.

The site is located near the eastern margin of the Crawford Upland Physiographic Province, and is characterized by rugged topographic features that include steep slopes. The unconsolidated overburden consists mainly of residual clays and silts. Waste material is separated from the underlying bedrock by a layer of clay. The bedrock is composed of thin limestone, sandstones, and shales assigned to the Mississippian-age West Baden Group that overlie a thick sequence of carbonate rock assigned to the Paoli and St. Genevieve Limestone of the Blue River Group. Valley bottoms immediately north and south of the saddle are eroded into lower parts of the St. Genevieve Limestone. The entire area is underlain by the St. Louis Limestone, the lowest unit of the Blue River Group. Three different members make up the St. Genevieve Formation, including (in descending order) the Levias Member, the Spar Mountain member, and the Fredonia Member. Thin shale chert (a type of rock) beds are also present.

Strata in the region generally dip or slope from the crest of the Cincinnati Arch to the west or southwest into the Illinois Basin at a rate of 25 to 30 feet per mile. Local variations of this regional trend occur. Correlation of chert marker beds in site boreholes suggests a northwesterly dip in the immediate area of the landfill.

The Paoli and St. Genevieve Limestones support development of dissolution features and karst. Numerous karst features, including sinkholes, sinking streams, caves, and springs, exist in the area. Subterranean flow routes from sinkholes, sinking streams, and wells to spring emergences in Conard's and Taylor Branches were identified during dye tracer tests. Subterranean drainage from Neal's Landfill is known to resurge at springs located at the head of Conard's Branch, collectively referred to as the Northwest Spring System.

Northwest Spring System

The Northwest Spring System includes North Spring, South Spring, and five storm water overflow springs in the vicinity of South Spring (see Figure 3). Dye tracer experiments and groundwater quality data both suggest that all the springs comprising the Northwest Spring System are common discharge points for a single groundwater flow system and that they are fed by a single solutional conduit flow system. Such common source overflow/underflow spring systems are common in the south-central Indiana karst area. The overflow springs are normally dry but contribute most of the discharge to Conard's Branch during high-flow storm events. During such storm events, flow from the springs may be continuous for several days. The springs are referred to as Overflows 0, 1, 2, 3, and 4. Overflow springs during storm events begin to flow in the order 0, 1, 2, 3, and 4. A small storm event may activate flow only in Overflows 0, 1, and 2. Larger storm events will also activate Overflow 3, and the largest storm events will activate Overflow 4.

North Spring is the lowest underflow spring associated with the Northwest Spring System. North Spring appears to be supplied by the South Spring conduit system as well as by independent drainage from adjacent areas. Lower PCB concentrations have been detected at North Spring, which reflects the dilution caused by this additional drainage contribution. Flow rates from the Northwest Spring System springs were gauged periodically from 1983 to 2001. Continuous measurements have been made since February 2001, primarily at a flow measurement weir on Conard's Branch located below South Spring. Flows at the weir may exceed 11,000 gpm during storm events. There is evidence that both peak flows and flow volumes from the Northwest Spring System have decreased since 1983. This has been attributed largely to surface drainage alterations that occurred at the landfill as a result of the 1999 source control remedial action. Prior to the waste removal and consolidation, surface water from approximately 102 acres around the landfill drained into sinkholes in the vicinity of the "cattail pond," contributing to the flow at the Northwest Spring System. During the source control operable unit, this surface water was redirected toward Taylor's Branch, and as a result, the flow at the Northwest Spring System has decreased substantially.

Aggregate flows from North Spring and South Spring of up to about 500 gpm are captured by lined catch basins and routed directly to the water treatment plant. At present, some of the flow from the Overflows 1, 2, and 3 is captured in small rip-rap-lined collection basins and is routed to the lined basin at South Spring. If spring flow exceeds the capacity of the water treatment plant, the excess flow overtops the lined basins and discharges directly to Conard's Branch. Modeling data show that the existing water treatment plant treats 47% of the spring flow and 38% of the PCB mass released from the Northwest Spring System.

Groundwater Basin and Delineation

A series of dye tracer tests were completed to delineate the size and location of the groundwater basin discharging at the Northwest Spring System. Dye was placed into a number of sinkholes and sinking streams in the area and springs were sampled for dye to determine if a connection existed. Figure 4 shows the subterranean connection established by the dye tracer tests and defines the area with groundwater draining to the Northwest Spring System. The dye tracer tests have indicated that the Northwest Spring System drains a total area of 350 to 400 acres that includes the 18-acre landfill area. Neal's Landfill is located at the extreme downstream end of the groundwater basin. It is thus apparent that a large volume of groundwater discharging at the Northwest Spring System is potentially affected by PCB releases that occur from a small area very close to the spring discharge points.

Karst Conduit Investigations

CBS conducted an extensive karst conduit investigation at Neal's Landfill to evaluate how the Northwest Spring System becomes contaminated with PCBs. The dye tracing results and measured flows in excess of 11,000 gpm indicate the spring system is supplied from a large, integrated karst conduit system. It was further recognized that the simplest and most direct way to evaluate PCB contamination of this conduit system was by direct access, mapping, and sampling. CBS identified several on-site and off-site sinkholes for potential connection to the conduit system. One sinkhole northwest of the landfill was excavated in September 2004 and found to provide direct access to the conduit system. The conduit was accessible both upstream and downstream of the excavation. Downstream entry in November 2004 revealed a network of small distributary cave passages supplying the various springs at the headwaters of Conard's Branch. CBS mapped about 75 feet of conduit passage. Dye tracing and pumping suggested that the conduit was the primary source of water to South Spring. Upstream exploration of the conduit was conducted during the period of July 2005 to September 2005. About 145 feet of conduit extending southeast of the sinkhole and toward the landfill was explored and mapped. Penetration ended at a passage constriction, and exploration of the conduit was discontinued because the passage was blocked and the safety concerns for the exploration team. Sediment samples collected from the cave floor contained up to 56 ppm PCBs. The conduit elevation was observed to be very close to the water level observed in adjacent monitoring wells.

In 2006, CBS directed attention toward finding the conduit at a location immediately upstream from the landfill. A geophysical study to locate conduits in this area was conducted in June 2006, with a follow-up survey using a different technique in August. This investigation focused on the southeast corner of the landfill where monitoring well data indicated that it might be possible to divert clean groundwater upgradient from the landfill and avoid PCB contamination as the water flowed beneath the landfill. The geophysical surveys suggested two areas where such conduits might be located. A total of six exploratory rock borings were drilled down to the water table in August 2006 at locations in these areas targeted by the geophysical surveys. The drilling was unsuccessful in finding the main conduit.

Two sinkholes south of the landfill were excavated in additional efforts to find the upstream conduit in September 2006. Both excavations were made down to the water table. Minor solution voids were found in the bedrock in both excavations, but neither encountered a significant lateral conduit.

The last phase of the conduit investigation was conducted in October 2006. Additional dye tracer tests were conducted from Sinkholes 2 and 5 upgradient of the landfill (see Figure 4) and dye monitoring was conducted at the August 2006 exploratory rock boring locations and at one of the excavated sinkhole areas. No dye was detected at any of these locations leading to the conclusion that there was no evidence that any of the exploratory borings (targeted by the geophysical methods) or the excavated sinkhole were located near the main upstream conduit.

Spring Water Sampling

South Spring has been sampled monthly during nonstorm conditions since the completion of the source control operable unit in 1999. PCB concentrations have ranged from 0.34 ppb to 2.6 ppb. Analysis of the data from South Spring shows that PCBs are always present in water from South Spring, but that levels are decreasing at about 6% per year. The highest PCB concentrations occur early during storm events. A total of 19 storm events have been sampled since the completion of the source control operable unit in 1999. Flows at the Conard's Branch weir have been as high as 12,250 gpm (March 12, 2006). A peak PCB concentration of 30 ppb was observed early during a storm on April

7, 2000. The most recent storm sampled on November 16, 2006, produced a peak flow of 7,500 gpm and a peak PCB concentration of 4.5 ppb.

Part of the southwestern portion of the site is known to drain to the southwest to Taylor Spring and Branam Spring. Since the completion of the source control operable unit in 1999, 30 samples have been collected at Branam Spring. Of these 30 samples, only 2 have detected PCBs, and these have shown PCB concentrations slightly above the detection limit of 0.1 ppb. Taylor Spring has been non-detect for PCBs during 20 of 24 events with the highest detected concentration at 0.2 ppb PCBs. Flow rates for both springs average less than 10 gpm but can be as high as 50 gpm during storm events. Monitoring at North Spring since the completion of the source control operable unit in 1999 has shown PCB concentrations ranging from 0.12 ppb to 2.1 ppb during low-flow conditions.

Sediment Investigations

Sediment investigations were completed both in Conard's Branch and Richland Creek. The main sediment sampling event occurred in 2004 and began with U.S. EPA completing a sediment thickness study in Conard's Branch and Richland Creek in November 2003. CBS performed its main sediment sampling event in October 2004, which began in Conard's Branch and continued to approximately 7 miles downstream in Richland Creek. The results of the sediment thickness study show that starting in Conard's Branch to where State Route 43 meets Richland Creek in Owen County (approximately 3 miles downstream), less than 500 cubic yards of sediment is present. A majority of the sediment measured by U.S. EPA during the sediment thickness study occurred downstream of the State Route 43 meets Richland Creek in Owen County, with over 12,000 cubic yards located between 3 and 7 miles downstream of the landfill.

A number of sampling events in and around Conard's Branch and Richland Creek have taken place over the years. The 2004 sampling event was the most recent and extensive and included in-stream surface sediment samples, in-stream deep core samples, bank soil samples, and floodplain soil samples. Surface sediment samples included the top one inch of sediment; bank samples included 0 to 3 inches and 3 to 6 inches in depth; floodplain samples included 0 to 3 inches, 3 to 6 inches and 6 to 9 inches in depth; and finally the deep sediment cores ranged from 0 to 29 inches depending on the sediment thickness. Figures 5 through 10 show (by stream section) the entire results of the 2004 sampling event. Within Conard's Branch, in-stream surface sediment samples show a PCB concentration range from below detection limit (< 0.1 ppm) to 3.0 ppm; bank soil samples show a PCB range from below detection limit (< 0.1 ppm) to 66 ppm; and floodplain soil samples show a range from below detection limit (< 0.1 ppm) to 19 ppm PCBs. Results show that Richland Creek has much lower concentrations of PCBs, that most samples collected were below the detection limit (< 0.1 ppm) and that all samples contained less than 1 ppm PCBs. All in-stream surface sediment samples were below the detection limit of 0.1 ppm PCBs, and all bank soil, floodplain soil (at the Vernal Pike bridge and Richland Creek), and deep core sediment samples were less than 1 ppm PCBs, with the highest result being 0.55 ppm in one deep core sediment sample.

CURRENT AND POTENTIAL FUTURE LAND AND WATER USES

The Neal's Landfill site is located in a rural setting, surrounded primarily by agricultural and wooded land. A few residences are located within one mile of the site. If the Sycamore Land Trust accepts the willed property, which includes the landfill property and a number of properties near the site, future development would be limited in the area surrounding the landfill.

Prior to September 2001, a majority of the homes surrounding Neal's Landfill were using wells as a drinking water source. A nearby quarrying operation affected the groundwater elevation of some nearby wells and the affected households have been placed on a rural water supply. Groundwater associated with the landfill was not affected from the quarrying operations and has not affected any nearby drinking water wells or sources. The latest well survey shows 13 residences using wells for drinking water within 1-mile of the site and PCBs have not impacted these wells. The drinking water well survey will be updated and wells may be sampled based upon the results of the survey.

SUMMARY OF SITE RISKS

U.S. EPA completed two focused risk assessments for the purpose of quantifying the threat to public health and the environment from actual or threatened releases of hazardous substances into the environment. One risk assessment focused upon the current and future effects of such releases on human health. The other assessment focused upon the current and future effects of such releases upon the environment. Each risk assessment is discussed, in turn, below.

Human Health Risks

A Superfund human health risk assessment estimates the baseline risk to human health. This is an estimate of the likelihood of health problems occurring if no cleanup action is taken at a site. To estimate the baseline risk at a Superfund site, U.S. EPA undertakes a four-step process:

Step 1: Analyze Contamination
Step 2: Estimate Exposure
Step 3: Assess Potential Health Dangers
Step 4: Characterize Site Risk

In Step 1, U.S. EPA evaluates the data collected at a particular site to determine which data are appropriate to consider in the risk assessment. For example, here the recent data are used rather than historical data because concentrations of PCBs in water and fish tissue can change over time and current data are most reflective of future concentrations. Next, U.S. EPA looks at the concentrations of contaminants found at a site, as well as past scientific studies on the effects these contaminants have had on people (or animals when human studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies help U.S. EPA to determine which contaminants are most likely to pose the greatest threat to human health.

In Step 2, U.S. EPA considers the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency and duration of exposure. Using this information, U.S. EPA calculates a reasonable maximum exposure (RME) scenario, which represents the highest level of human exposure that could reasonably be expected to occur.

In Step 3, U.S. EPA uses the information from Step 2, combined with information on the toxicity of each chemical to assess potential health risks. U.S. EPA considers two types of risk: cancer and non-cancer. For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

Where: Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are usually expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the RME estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the cancer risks individuals face from other causes such as smoking or exposure to too much sun. The chance of an individuals developing cancer from all other causes has been estimated to be as high as one in three. U.S. EPA's generally acceptable risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (referred to as an exposure duration; e.g., 30 years for an adult resident) with a reference dose (RfD) derived for a similar exposure period. A RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of potential concern within a medium or across all media to which a given individual may reasonably be exposed. A HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. A HI greater than 1 indicates that site-related exposures might present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where: CDI = Chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic).

In Step 4, U.S. EPA determines whether site risks are great enough to cause health problems for people at or near the Superfund site. The results of the three previous steps are combined, evaluated and summarized. U.S. EPA adds up the potential risks from the individual contaminants and exposure pathways and calculates a total site risk. In the evaluation of risk, a potential upper-bound risk of 1 in 1,000,000 extra cancer case is used by U.S. EPA as a point of departure for determining remediation goals, but a probability as high as 1 in 10,000 extra cancer case is acceptable in some circumstances.

PCBs are the only chemical of concern at the Neal's Landfill site. U.S. EPA calculated PCB risks at Neal's Landfill site through two methods (Aroclor and Toxicity Equivalents [TEQ]). Laboratory analysis included measuring PCBs by the Aroclor method and the congener method. With the congener method, thirteen of the 209 congeners are referred to as dioxin-like PCBs, as they produce a toxic response similar to 2, 3, 7, 8-tetrachloro-p-dioxin (TCDD). The concentration of each congener is converted to a dioxin equivalent, which is referenced as the TEQ. U.S. EPA has proposed an alternate slope factor for TCDD, which is more conservative, but this has not been finalized.

In evaluating the human health risks posed by the remaining PCB releases from Neal's Landfill, U.S. EPA focused on the health effects to children, youths, and adults coming into contact with water, sediment, and soil (including bank soil and floodplain soil) in and along Conard's Branch and Richland Creek, along with eating fish from Richland Creek. U.S. EPA believes that human exposure to PCBs from the site results from the following pathways:

- Consumption of fish from Richland Creek by an adult recreational fisherman who consumes between one (1-mile site) and three (12.7-mile site) half-pound meals per month.

- Exposure to sediment within Conard's Branch and Richland Creek through skin contact and incidental ingestion through recreational activities.

- Exposure to surface water within Conard's Branch and Richland Creek through skin contact and incidental ingestion through recreational activities.

- Exposure to soil (including bank soil and floodplain soil) in and along Conard's Branch and Richland Creek through skin contact and incidental ingestion through recreational activities.

Extensive fish sampling was conducted in both Conard's Branch and Richland Creek over the years. In Richland Creek, fish sampling has occurred as far as approximately 35 miles downstream of the landfill (see Figure 2 and Figure 11). Since the completion of the source control remedy, fish were collected for PCB analysis on one occasion at a location 12.7 miles downstream from the landfill, on three occasions at locations 3 and 5.5 miles downstream from the landfill, and on five occasions at a location 1 mile downstream from the landfill. Both pelagic fish (water-column swimming fish such as longear sunfish and rock bass) and benthic fish (bottom-dwelling fish such as white sucker) were sampled. Conversion factors of one-quarter and one-half were used to convert whole pelagic and benthic fish PCB concentrations, respectively, to fillet PCB concentrations. The sampling locations used in Richland Creek and average PCB fish concentrations are shown in Table 1.

Table 1 – Summary of Average PCB Fish Concentrations

Fish Tissue	1-Mile Site	3-Mile Site	5.5- Mile site	12.7-Mile Site
Pelagic – PCBs in ppb	182	114.8	NA	92
Pelagic – TEQ in ppt	3.0	1.0	NA	NA
Benthic – PCBs in ppb	808	182.8	192	165
Benthic – TEQ in ppt	10.2	1.4	2.3	NA
ppb – parts per billion	ppt – parts per trillion		NA – No Available Data	

In evaluating the risk, U.S. EPA determined that the fish in Conard's Branch were not of sufficient size or type to justify further consideration in the human health risk assessment. As for evaluating risks to humans from the consumption of fish from Richland Creek, an analysis of the amount of fish within the creek was completed to determine if enough fish were available to consume. CBS only completed population studies at the 1-mile site. At the 3-mile site, 5.5-mile site and 12.7-mile site, U.S. EPA estimated the ingestion rates based upon primary factors known to affect the distribution, abundance, and community structure of fish in streams similar to Richland Creek. The size of the fish were also taken into consideration in developing the amount of fish that can be consumed along with a factor for converting whole fish sample results to an edible fillet concentration. Pelagic and benthic fish ingestion rates were also adjusted to reflect a relative presence of 80 and 20 percent pelagic and benthic fish, respectively, in the total biomass. Table 2 below shows the fish tissue ingestion rates at the sampling locations.

Table 2 – Summary of the Fish Tissue Ingestion Rates

	Location-Specific Fish Tissue Ingestion Rates (grams/day)			
Feeding Guild	**1-Mile Site**	**3-Mile Site**	**5.5-Mile Site**	**12.7-Mile Site**
Pelagic Fish	6	7.3	9.2	18.3
Benthic Fish	1.5	1.8	2.3	4.6
Total	7.5	9.1	11.5	22.9

Table 3 below gives a summary of the carcinogenic and non-carcinogenic risks associated with the ingestion of fish at each of the fish sampling locations.

Table 3 – Summary of Site Risks Based Upon Ingestion of Fish

Location	Fish	PCB Risk (Aroclor)	PCB risk (TEQ)	Hazard Index (Aroclor)	Hazard Index (TEQ)
1-Mile	Pelagic	6.7×10^{-6}	8.3×10^{-6}	0.39	0.13
	Benthic	7.4×10^{-6}	7.0×10^{-6}	0.43	0.11
3-Mile	Pelagic	5.1×10^{-6}	3.4×10^{-6}	0.3	0.052
	Benthic	2.0×10^{-6}	1.2×10^{-6}	0.12	0.018
5.5- Mile	Pelagic	-	-	-	-
	Benthic	2.7×10^{-6}	2.4×10^{-6}	0.16	0.038
12.7-Mile	Pelagic	1.0×10^{-5}	-	0.6	-
	Benthic	4.6×10^{-6}	-	0.27	-

The results from Table 3 show the following:

- Total risks vary moderately by location; that is, risks for the 1-, 3-, 5.5-, and 12.7-mile sites are similar. (Note: Risks at the 5.5-mile site are lower than at the other sites.) Likewise, risks for pelagic and benthic fish are similar at the 1-mile site; at the 3- and 12.7-mile sites, benthic fish risks are about two to three times higher than risks associated with pelagic fish.

- Total risks based on total PCBs range from 1.5×10^{-5} (about 2 in a population of 100,000) based on ingestion of both pelagic and benthic fish at the 12.7-mile site to 2.7×10^{-6} (about 3 in a population of 1,000,000) at the 5.5-mile site.

- Risks calculated based on total PCBs match closely with those calculated based on TCDD TEQs using the existing SF (1.5×10^{5} [mg/kg-day]$^{-1}$). Risks based on U.S. EPA's proposed alternative TCDD SF (1x 10^{6} [mg/kg-day]$^{-1}$) are about 5 to 10 times higher than those based on total PCBs and 6 to 7 times higher than those based on the TCDD TEQ using the current TCDD SF.

- Risks based on total PCBs and assuming ingestion of both pelagic and benthic fish fall within U.S. EPA's generally acceptable risk range for site-related exposures (1×10^{-4} to 1×10^{-6}) at all locations and equaled or exceeded 1×10^{-5} only at the 1- (1.4×10^{-5}) and 12.7-mile (1.5×10^{-5}) sites.

- Risks based on TCDD TEQs and the existing SF (1.5×10^{5} [mg/kg-day]$^{-1}$) and U.S. EPA's proposed SF (1.0×10^{6} [mg/kg-day]$^{-1}$) also fall within U.S. EPA's generally acceptable risk range at all locations assuming ingestion of both types of fish.

- Hazards do not vary significantly by location or fish type; that is, hazards for the 1-, 3-, 5.5-, and 12.7-mile sampling locations are similar. (Note: As for risks, hazards at the 5.5-mile site are lower than at the other sites). Likewise, hazards for pelagic and benthic fish are similar at the 1-mile site. At the 3- and 12.7-mile sites, pelagic fish hazards are two to three times higher than hazards associated with benthic fish.

- Hazards based on total PCBs and ingestion of both pelagic and benthic fish are less than 1 at all locations.

- Hazards calculated based on total PCBs do not match as closely with those calculated based on TCDD TEQs as the risks. Hazards based on TCDD TEQs range from about 3 to 6 times lower than hazards based on total PCBs.

- Hazards based on TCDD TEQs are less than 1 at all locations assuming ingestion of both types of fish.

Other exposure pathways in Conard's Branch and Richland Creek besides fish tissue ingestion were evaluated for risk. Table 4 below is a summary of the average PCB concentrations in surface water, soil, and sediment for use in the risk calculations.

Table 4 – Summary of the Average PCB Concentrations

Exposure Point	Surface Water (ppm)	Sediment (ppm)	Bank Soil (ppm)	Floodplain Soil (ppm)
South Spring	1.25×10^{-3}	-	-	-
North Spring	6.76×10^{-4}	-	-	-
Conard's Branch	5.56×10^{-4}	1	7.2	3.6
1-Mile Site	1.04×10^{-4}	1.04×10^{-4}	-	-
3–Mile Site	1.5×10^{-4}	1.5×10^{-4}	-	-
5.5-Mile Site	-	-	-	-
12.7-Mile site	-	-	-	-
Section B	-	3.2×10^{-2}	-	2.2×10^{-1}
Section C	-	-	1.4 x 10-2	-
Section D	-	1.9×10^{-2}	-	-
Section E	-	2.7×10^{-2}	2.4×10^{-1}	-
Section F	-	3.6×10^{-1}	-	-
Section G	-	2.1×10^{-1}	-	-

The values in Table 4 were used in the calculation of dermal contact and incidental ingestion risks and the following is a summary of the PCB results:

- Dermal contact and incidental ingestion of surface water in Conard's Branch and Richland Creek produce a cancer risk of less than 3 in 1,000,000.

- Dermal contact and incidental ingestion of surface water in Conard's Branch and Richland Creek produce a non-cancer risk using the hazard index for PCBs of less than 1.

- Dermal contact and incidental ingestion of Conard's Branch and Richland Creek floodplain soil, bank soil and sediment produce a cancer risk of less than 1 in 1,000,000.

- Dermal contact and incidental ingestion of Conard's Branch and Richland Creek floodplain soil, bank soil, and sediment produce a non-cancer risk using the hazard index for PCBs of less than 1.

In addition, IDEM has set fish advisories to inform individuals as to the risk of eating fish from Richland Creek. Near the Neal's Landfill site, IDEM has categorized the creek as having a Group 3 fish advisory, which indicates the general population can eat one meal per month safely (except pregnant, pre-pregnant, breastfeeding women, and children do not eat). For creek chub greater than 7 inches and suckers greater than 11 inches, the advisory is Group 4, which indicates one meal every two months for the general population and the same exceptions as Group 3.

Using the information from the human health risk assessment and considering the Richland Creek stream characteristics, U.S. EPA determined that 0.2 ppm PCBs in fillets would be the fish remediation goal.

Ecological Risks

To evaluate the risk to ecological receptors, U.S. EPA follows a procedure similar to the four-step procedure described above with respect to the human health risk assessment. The ecological risk assessment for the Neal's Landfill site focused on whether exposure to PCBs by mammals and birds feeding on contaminated fish and crayfish from Conard's Branch and Richland Creek is high enough to potentially cause reproductive problems. Protection of fish-eating birds and mammals is expected to be protective of aquatic organisms as well because PCBs bioaccumulate in species as they are passed through the food chain. Therefore, animals that feed on fish are exposed to higher levels of PCBs compared to the fish themselves. Fish-eating mammals are represented by mink, and fish-eating birds are represented by kingfisher.

The exposures to mink and kingfisher are based on analyses of fish collected from Conard's Branch and Richland Creek in August 2001, November 2002, and May 2003 and crayfish collected in May 2003. Fish data collected in November 2005 was also analyzed. The ecological risk assessment fish sampling locations are Conard's Branch, Richland Creek at Vernal Pike, Richland Creek at the Route 43 bridge in Owen County, Richland Creek (5.5 miles downstream), Richland Creek and the Route 43 bridge in

Hendricksville (12.7 miles downstream), Richland Creek northwest of the town of Solsbery (21.8 miles downstream), and Richland Creek at the State Route 54 bridge in Bloomfield (34.5 miles downstream).

PCB concentrations in crayfish were also included in the exposure estimates for mink and kingfisher. Because crayfish were not collected at all sites or times, the ratio of PCB concentrations in co-located fish and crayfish in 1982 and 1998 was used to model PCBs in crayfish from measured fish data to fill in missing crayfish data. Risk is evaluated both for total PCBs and for dioxin TEQ. Missing crayfish TEQ data are modeled from fish data based on co-located fish and crayfish samples collected in 2003. Risks are calculated for both RME, which is based on an upper estimate of the average PCB or TEQ exposure, and central tendency exposure (CTE), which is based on the average measured exposure.

Mink exposure is modeled with a dietary composition of 66% fish, 13% crayfish, and 21% prey from land, based on a field study in Michigan, and assuming no PCB contribution from non-aquatic prey. Risk is estimated by HQs calculated by dividing the modeled dietary PCB concentrations by the dietary concentration resulting in no adverse effects in mink feeding studies (no effect HQ) and the lowest concentration that caused adverse effects (low effect HQ).

The results for total PCBs and TEQ using the fish sampling data show that mink are at risk of adverse reproductive effects to at least 2 miles downstream from the landfill. Between 3 and 5.5 miles downstream from the site, limited data exist to calculate the risk, but it is possible that some risk exists. Low to no risk exists beyond 13 miles downstream from the landfill. A dead mink was discovered on the State Route 48 and Richland Creek bridge in 2004, and the United States Fish and Wildlife Service sampled the liver of the mink for PCB analysis. Calculating the risk to the mink using the PCB and TEQ liver data showed that risk may be near the lowest level for reproductive effects. These risk results are consistent with the risks calculated using fish data.

Kingfisher exposure is modeled with a dietary composition of 80% fish and 20% crayfish based on several field studies in Midwestern states. PCB toxicity studies have not been performed with kingfisher; therefore, to allow use of toxicity data for other species of birds, kingfisher dietary exposure was converted to dose (PCBs or TEQ per kilogram body weight per day). Since the sensitivity of kingfisher to PCBs is unknown, two sets of PCB toxicity values were used to represent higher and lower sensitivities to PCBs. The risk associated with TEQ dose was evaluated with a single high-quality set of toxicity values. TEQ risk was also evaluated through a separate procedure by modeling the accumulation of dioxin-like PCB congeners in kingfisher eggs. The risks associated with TEQ in eggs were assessed with two sets of toxicity values to represent higher and lower sensitivities to dioxin-like effects.

The range of toxicity values used for kingfisher resulted in a range of risk estimates, with the egg-based approach showing higher risk compared to the ingestion dose-based approach. The range of overlap in risk estimates between the two kingfisher approaches is referred to as "consensus HQs." The consensus HQs were selected as the best estimates of kingfisher risk because they represent the convergence of separate approaches based on independent estimates of toxicity. The kingfisher consensus HQs show similar trends as the mink risk estimates – risk of adverse reproductive effects to at least 2 miles downstream from the landfill; possible risk between 3 and 5.5 miles downstream, but with very limited data; and no or low risk beyond 13 miles downstream. An additional line of evidence is the potential risk to fish due to measured accumulation of dioxin-like PCB congeners in fish tissue. The toxicity data are based on a laboratory study of long-term exposure of rainbow trout to dioxin. The focused risk assessment showed risk of growth suppression and behavioral impairment in fish in Conard's Branch and the upper portion of Richland Creek. The downstream extent of elevated risk to fish is similar to that for mink or kingfisher, after adjusting the fish risk estimates for reported differences among fish species in dioxin sensitivity.

The RME no effect HQs for mink feeding in Richland Creek within 2 miles of Neal's Landfill range from 2 to 9 and the low effect HQs range from 1 to 2. The RME consensus HQs for kingfisher range from 4 to 20 for no effect, and 1 to 4 for low effect in the same reach. The risk estimates are much higher for foraging in Conard's Branch, the closest reach to Neal's Landfill; however, Conard's Branch is not large enough to fully support either mink or kingfisher, so risks were estimated by assuming combined foraging in Conard's Branch and Richland Creek. The RME no effect HQs for mink feeding in both Conard's Branch and Richland Creek range from 3 to 20, and the low effect HQs range from 2 to 6. The RME consensus HQs for kingfisher range from 9 to 60 for no effect, and 3 to 10 for low effect over the same reaches.

The risk estimates were used to calculate fish PCB goals that are expected to be protective of mammals or birds feeding on fish downstream of Neal's Landfill. The goals in Richland Creek are 0.7 ppm (no effect) to 0.9 ppm (low effect) PCBs in whole-fish based on risk to mink, and 0.25 to 0.9 ppm (no effect) to 1.2 to 2.6 ppm (low effect) PCBs based on risk to kingfisher. A separate set of fish goals was calculated for Conard's Branch assuming feeding in both Conard's Branch and Richland Creek. The goals in Conard's Branch are 1.8 ppm (no effect) to 2.3 ppm (low effect) PCBs in whole-fish based on risk to mink, and 0.5 to 2 ppm (no effect) to 2.4 to 5 ppm (low effect) PCBs based on risk to kingfisher. The wider range of goals for kingfisher reflects the greater uncertainty over PCB effects in kingfisher compared to the well-studied effects in mink.

REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives (RAOs) for the site are the following:

- Reduce the amount of PCBs released from groundwater to Conard's Branch and Richland Creek through mass reduction.

- Improve PCB levels in fish for beneficial reuse by reducing PCBs released to Conard's Branch and Richland Creek.

- Reduce the amount of PCB mass in sediments that may be available to fish by reducing PCBs released.

The RAOs were developed for the purpose of developing an array of alternatives. Based upon the human health and ecological risk assessments, the remediation goals for the site will focus on fish tissue. Based upon the human health risk assessment, the remediation goals will be to reduce PCB concentrations to a level of 0.2 ppm in fillets within Richland Creek. This would allow a maximum of one meal of fish per week by all populations. The fish sampling location in Richland Creek at the State Route 48 and State Route 43 bridge, about 3 miles downstream from the site, will be used for future fish sampling since that location is capable of producing enough fish to support sport fishing.

Based upon the ecological risk assessment and using the mink as the target organism, Table 5 is a summary of the remediation goals based upon whole fish (assumes mink feeding 75% of the time in Richland Creek and 25% of the time in Conard's Branch). These PCB fish remediation goals are also protective of kingfisher.

Table 5 - Summary of Ecological PCB Remediation Goals

Location	PCB Remediation Goals (ppm)
Conard's Branch – Average whole fish concentration	1.8 to 2.3
Richland Creek at Vernal Pike – Average whole fish concentration	0.7 to 0.9

DESCRIPTION OF ALTERNATIVES

Groundwater and Sediment Operable Unit

Disposal of capacitors containing PCB oil and other PCB waste material from the former Westinghouse capacitor plant at Neal's Landfill have resulted in PCBs migrating deep into the karstic limestone bedrock. High concentrations of PCBs were discovered during the 1999 source control excavation in the southeast portion of the site. In addition, sampling of water and sediment during the 2005 cave entry showed PCBs in both the water and sediment. The southeast corner of the site and conduits that travel under the landfill hold a reservoir of potentially mobile PCBs. Numerous hydraulic tests show a direct connection between the conduits and the Northwest Spring System.

The karst conduit investigation indicates that the Northwest Spring System is the discharge point for an approximate 350 to 400-acre groundwater drainage basin. The spring system flows in direct response to rainfall and infiltration to the groundwater system within this area. U.S. EPA analyzed spring flow records and determined that the mean hourly spring flow for the Northwest Spring System is about 400 gpm. Although flow rates can be much lower than that in the summer months, peak flow rates during storm events can be higher than 11,000 gpm. PCBs are present in the Northwest Spring System discharge at all flow rates.

Before the 1999 source control cleanup, Neal's Landfill covered approximately 18 acres. The source control operable unit cleanup reduced the size of the landfill to approximately 10 acres. The 10-acre landfill only occupies a small portion of the approximately 400-acre Northwest Spring System drainage basin. The karst cave investigation and groundwater basin study has not demonstrated that clean water upgradient from the landfill can be diverted around the landfill. Moreover, PCBs in the karst bedrock cannot be effectively contained, removed, or treated by remedial action focused at the landfill. U.S. EPA concludes that the capture of PCBs at any point, or points, within the karst drainage system upstream from the Northwest Spring System is unlikely because of the inability to locate any major conduits where groundwater flows could be intercepted and diverted away from the contaminated areas under the landfill. Therefore, U.S. EPA's approach is to control PCBs released from the landfill by treating the discharge from the Northwest Spring System, which is the point where PCB-contaminated groundwater emerges from the groundwater system and flows into the headwaters of Conard's Branch.

The release of PCBs from Neal's Landfill has also contaminated sediment with PCBs in Conard's Branch and Richland Creek. Sediment contaminated with PCBs will affect the PCB levels in fish tissue. The sediment sampling results from Richland Creek show nearly all samples less than 1 ppm PCBs. Also, there is little or no sediment in Conard's Branch or Richland Creek until approximately 3 miles downstream of the landfill. Based upon the lack of sediment and the results of the human health and ecological risk assessments, no sediment cleanup was evaluated for Richland Creek. In Conard's Branch, in-stream sediment, bank soils and floodplain soils show a number of locations with PCB contamination greater than 1 ppm.

Fate and Transport Model

To assist in the development and evaluation of the alternatives for the groundwater and sediment operable units, CBS developed a PCB fate/transport and bioaccumulation model. The model was used to predict future levels of PCBs in fish in Conard's Branch and Richland Creek following the assumed implementation of a variety of different potential remedial action alternatives. As described in the Remedial Action Objectives section, the (1) remediation goal for human health is 0.2 ppm PCBs in fillets within Richland Creek and (2) ecological remediation goals are average whole fish concentrations in Conard's Branch of 1.8 to 2.3 ppm PCBs and average whole fish concentrations in Richland Creek of 0.7 to 0.9 ppm PCBs. These remediation goals were used in the fate and transport model to assist U.S. EPA in determining the best alternative to address the continuing release of PCBs from the Northwest Spring System.

Models have been used at a number of sites to assist the U.S. EPA in decision-making. The model developed by CBS relies upon various components that have been peer-reviewed by U.S. EPA in the past in connection with the cleanup of other sites. Models are a series of mathematical equations that describe the processes controlling contaminant exposure. For PCB exposure in a groundwater and surface water system like Neal's

Landfill, there are four groups of important processes that occur. The four sub-models or parts of the overall model are hydrodynamic, sediment transport, PCB fate, and PCB bioaccumulation. Data collected at the site, along with data from literature and experiences from modeling other systems, are used in the model to describe the Neal's Landfill groundwater and surface water system. To calibrate the model, extensive site-specific data such as sediment PCB concentrations, surface water flow data, PCB water sampling data obtained during storm and non-storm events, and fish and aquatic biota data were used to ensure that the model is as accurate as possible. The modeling effort provides valuable insights regarding the factors that control transport and fate of PCBs in Conard's Branch and Richland Creek.

The fate and transport model was used to quantify the relative importance of the various PCB sources to fish such as spring base flow, spring storm flow, water treatment plant effluent, in-stream sediments, and groundwater seeps along Conard's Branch. This type of assessment as to how each PCB source affects PCB concentrations in fish is helpful in developing and evaluating remedial alternatives. Table 6 below shows the results from the fate and transport model regarding the approximate contributions of spring water flow rates to PCB concentrations in fish.

Table 6 – Contribution of Water Sources to Fish PCBs Under Different Flow Regimes

Location	Species	Conard's Branch Weir - Low Flow < 10 gpm	Conard's Branch Weir - Moderate Flow 10 to 500 gpm	Conard's Branch Weir - High Flow > 500 gpm
Conard's Branch	Creek Chub	67%	22%	11%
Richland Creek at Vernal Pike	Creek Chub	42%	27%	31%
	Longear Sunfish	44%	27%	29%

Table 6 shows that the contributions of uncollected spring water flows to Conard's Branch when weir flows are less than 10 gpm provide the biggest source of PCBs to fish since these conditions are prevalent during the summer months when fish achieve much of their annual growth. High spring water flow conditions, and to a lesser extent, moderate spring water flow conditions contribute less PCBs to Conard's Branch fish since they are less frequent and last no longer than several days, which limits the ability of the fish to uptake the PCBs. In Richland Creek, low spring water flow conditions produce less of an effect on PCB levels in fish because the PCB concentrations in Richland Creek are diluted as compared to the PCB concentrations found in low-flow conditions at Conard's Branch.

In addition to evaluating how water flows influence PCB concentrations found in fish, the fate and transport model evaluated how the various sources of PCBs influence PCB concentrations in fish. Four sources of PCBs to fish were evaluated. The available PCB sources include (1) water that bypasses collection in Conard's Branch, (2) effluent from the current water treatment plant, (3) North Spring area seeps that bypass the current collection system, and (4) sediment. The seeps near North Spring were discovered through sampling within Conard's Branch. The sampling results in Conard's Branch showed that these seeps were not being collected by the North Spring collection system resulting in low levels of PCBs being untreated within Conard's Branch. Table 7 below shows the approximate contribution of sources to PCB levels in fish.

Table 7 – Approximate Contribution of Sources to PCB Levels in Fish

Location	Species	Water From Northwest Spring System	Effluent from Water Treatment Plant	North Spring Area Seeps Bypass Water	Sediments
Conard's Branch	Creek Chub	24%	11%	37%	27%
Richland Creek	Creek Chub	36%	8%	21%	35%
	Longear Sunfish	24%	6%	14%	56%

For example, Table 7 shows that the fate and transport model predicts that creek chub in Conard's Branch receive 24% of its PCBs from the water coming from the Northwest Spring System that bypasses collection, 11% of the PCBs from the effluent leaving the current water treatment plant, 37% of PCBs from the North Spring area seeps, and 27% of PCBs from the sediment in Conard's Branch.

To further evaluate the PCB sources, comparisons of PCB sources to water under both storm and low-flow conditions were also developed as shown in Figure 11. During storm flows, 98% of the PCBs in Conard's Branch are produced from the Northwest Spring System, 0.8% of PCBs to the water in Conard's Branch comes from the water treatment plant effluent, 1% of the PCBs to the water in Conard's Branch are from the North Spring area seeps, and 0.1% of the PCBs in Conard's Branch during storm events are from sediments in Conard's Branch. During low flow events, 9% of the PCBs to water in Conard's Branch come from the Northwest Spring System, 22% of the PCBs are from the water treatment plant effluent, 53% of the PCBs to water are from the North Spring area seeps and 16% of the PCBs to water in Conard's Branch come from the sediments.

Comparing Table 7 and Figure 11 shows that the source of PCBs in creek chubs within Conard's Branch are similar to the source of PCBs during low flow providing additional evidence that PCBs within Conard's Branch fish are controlled by low-flow PCB sources.

In summary, key findings of the fate and transport model are as follows:

- Storm events producing flows greater than 500 gpm do not produce a major effect on PCB levels in fish due to the large flows not producing a long period of exposure, which limits the PCB bioaccumulation in fish.

- PCB concentrations in fish are affected most by PCB-contaminated spring water during low-flow periods. Currently, 37% of the PCBs contributed to creek chub in Conard's Branch are from the North Spring area seeps which currently bypass collection.

- Sediment contamination and stream bank contamination in Conard's Branch have an effect on PCB levels in creek chub, with sediments and bank soils contributing 27% of the PCBs found in the fish.

Technical Impracticability Waiver

This Technical Impracticability (TI) Waiver relates only to the point source discharge at the point of water treatment prior to discharge to the creek during storm events. Since site investigations at Neal's Landfill have failed to define a plume in the karst geology and a definable plume does not appear to exist, it is not possible to set cleanup goals for the groundwater that would allow beneficial reuse consistent with CERCLA Section 121(d)(2)(A).

As described previously, disposal of capacitors containing PCB oil and other PCB waste material from the former Westinghouse capacitor plant at Neal's Landfill have resulted in PCBs migrating deep into the karstic limestone bedrock. During the 1999 source control operable unit, high concentrations of PCB-contaminated material were discovered during excavation of the southeast portion of the site, and many areas were excavated to bedrock due to these high concentrations. The southeast portion of the site is known from dye tracer testing to drain via a system of karst dissolution conduits to the Northwest Spring System. These conduits contain a mobile reservoir of PCBs that are released through the spring system. The Northwest Spring System is the discharge point for a groundwater drainage basin of approximately 400 acres. Spring flow is in direct response to rainfall and infiltration to the groundwater system within this area. Although the 10-acre landfill occupies only a small portion of this drainage area, it is located in the extreme downstream portion of the groundwater basin and in a position to contribute PCBs to the drainage from the entire area.

Experience has shown that conventional recovery-well systems typically utilized in porous media environments are not likely effective in recovery of contaminated groundwater in karst environments. Extensive site-specific investigations at Neal's Landfill have shown that it not is possible to isolate the drainage from the landfill area in a manner that would allow capture or treatment of only the landfill groundwater. Consequently, the upstream most recovery points for affected groundwater are the spring orifices. Control of the PCB releases to Conard's Branch must therefore involve control and treatment of the large volumes of Northwest Spring System flow.

Flow from the Northwest Spring System has been measured for many years, and since February 2001, the mean annual spring flow rate is about 400 gpm. Although flow rates can be much lower than that in the summer months, peak flow rates during storm events are routinely higher than 11,000 gpm and flows greater than 500 gpm can last for many days, depending on seasonal factors and the rainfall distribution.

Evaluating the flow data from the Northwest Spring System since February 2001 shows one particularly large flow event. For 21 days beginning on December 29, 2004, approximately 61.4 million gallons of water bypassed the 500 gpm water treatment plant. The 61.4 million gallons of water are equivalent to 188 acres of water, one foot in depth. To contain 61.4 million gallons of water for treatment would require a large number of storage tanks or a large lagoon. At the Illinois Central Spring water treatment plant, two storage tanks each store 600,000 gallons of stormwater. When flows are reduced from the spring, the water within the tanks is drained and treatment of the stormwater can occur. If the equivalent size storage tanks were used at Neal's Landfill for the Northwest Spring System, 102 storage tanks would be required. Construction costs of the tanks would be over $66 million dollars.

In contrast to storage tanks, a large lagoon was evaluated to store the stormwater from the Northwest Spring System. A lagoon storing stormwater 4 feet in depth would require 47 acres. The size of the lagoon could vary depending upon the depth of the water within the lagoon. For example, water 10 feet in depth would require a lagoon of approximately 19 acres to store the 61.4 million gallons of stormwater.

Constructing 102 storage tanks each capable of storing 600,000 gallons is not practicable due to the large area required to place the 102 storage tanks. More appropriate would be the use of a storage lagoon. If a 47-acre lagoon was used, the difficulty in finding the required space along with the construction difficulties due to the requirement of removing significant quantities of rock and ensuring the containment of the water make constructing a large lagoon technically impracticable from an engineering perspective. Another problem with addressing such a large volume of water is the time required to treat the stored water. Assuming the 500 gpm water treatment plant is treating 100 gpm from the Northwest Spring System and 400 gpm from the storage lagoon, it would require 106 days to drain. This timeframe would produce additional storms so the likelihood that the lagoon would be consistently filled with water is high. This lagoon would be an attractive nuisance to both humans and ecological receptors. Ecological receptors such as geese and ducks using the storage lagoon would be exposed to PCB-contaminated water at higher concentrations compared to Richland Creek or Conard's Branch.

Taking into consideration the limitations of the site available to construct the storage areas and the impediments to keeping the unit operational under such conditions, the U.S. EPA is exercising a TI waiver of the National Pollution Discharge Elimination System (NPDES) substantive requirements for stormwater flow greater than 500 gpm that bypasses the water treatment plant.

The TI waiver applies to all the alternatives and is being implemented under CERCLA Section 121(d)(4)(C) which is technical impracticability from an engineering perspective. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) waived are discussed in the Evaluation Criteria for Superfund Remedial ARARs section.

Remedy Components

After evaluating the PCB sources to water and fish, remedial alternatives were developed to address the unacceptable ecological and human health risk. The alternatives were evaluated in the fate and transport model to determine if the PCB risk goals developed for fish (See Remedial Action Objectives Section) could be met. Including the "No Action Alternative," U.S. EPA evaluated seven alternatives to address contaminated groundwater and sediment caused by Neal's Landfill. The No Action Alternative must be evaluated as part of all Superfund remedy decisions. Under U.S. EPA's regulations, the "No Action Alternative" can include continuation of interim remedial measures, such as the continued operation of the water treatment plant built as an interim measure under the 1985 Consent Decree. Nevertheless, U.S. EPA also considered the alternative of shutting off this water treatment plant.

The development of the alternatives took into consideration the continued use of the current 450 gpm water treatment plant, which can treat up to 500 gpm. Due to the technical impracticability of storing all the stormwater that bypasses the water treatment plant, storage of a smaller amount of stormwater was evaluated.

Seven alternatives were developed based upon the ability to address springs at base flow, springs at storm flow, the North Spring area seeps and sediment. U.S. EPA did evaluate the possibility of capturing a smaller volume of stormwater compared to storing all of the stormwater. A storage volume of 2 million gallons was evaluated in the fate and transport model. These seven alternatives were evaluated in detail in the fate and transport model and are as follows:

- Alternative 1- No Action (this Alternative would shut down the current 500 gpm treatment system).
- Alternative 2 – Continue to operate the 500 gpm water treatment plant.
- Alternative 3 – Continue to operate the 500 gpm water treatment plant with improvements to the water collection system, and perform a sediment and floodplain cleanup in Conard's Branch.
- Alternative 4 – Continue to operate the 500 gpm water treatment plant, add 2 million gallons of stormwater storage, improve the water collection system, and perform a sediment and floodplain cleanup in Conard's Branch.

- Alternative 5 – Expand the current water treatment plant to 1,000 gpm, improve the water collection system, and perform a sediment and floodplain cleanup in Conard's Branch.

- Alternative 6 - Expand the current water treatment plant to 1,000 gpm, add 2 million gallons of stormwater storage, improve the water collection system, and perform a sediment and floodplain cleanup in Conard's Branch.

- Alternative 7 – Continue to operate the 500 gpm water treatment plant, improve the water collection system, add three stormwater settling basins, and perform a sediment and floodplain cleanup in Conard's Branch.

The seven alternatives were each evaluated in the fate and transport model to determine if the fish goals would be met if the alternative was implemented. Table 8 shows the expected percentage of PCB reduction in fish concentrations predicted by the model for each of the seven alternatives 10 years after the implementation of the alternative.
As described in the Remedial Action Objectives section, the objectives of the groundwater and sediment operable units are to reduce the amount of PCBs that are released in Conard's Branch and Richland Creek and to meet the remediation goals developed for fish tissue in the ecological and human health risk assessments. The fate and transport model predicts that spring water during storm events, which is not currently captured for treatment by the existing water treatment plant, does not have an unacceptable effect on PCB fish-tissue levels. It appears that the PCB-contaminated water released during storm events has little effect on fish because the duration of the conditions during storms does not produce a long enough exposure to greatly affect the PCB concentrations in fish. For Alternatives 3 through 7, the model predicts that the fish tissue remediation goals for both ecological and human health will be met within 10 years after the remedy is constructed.

Table 8 – Percent Reduction in PCB Levels in Fish Tissue After 10 Years

Alternative	Description of Alternative	% Reduction Year 10 Average Conard's Branch Creek Chub	% Reduction Year 10 Average Richland Creek Creek Chub	% Reduction Year 10 Average Richland Creek Longear Sunfish
1	No Action	0%	0%	0%
2	Current 500 gpm Treatment System	69%	63%	51%
3	Water Collection System Improvement + Sediment Cleanup to 1 ppm PCBs + 500 gpm Treatment System	83%	69%	56%
4	Water Collection System Improvement + Sediment Cleanup to 1 ppm PCBs + 500 gpm Treatment System + 2 Mgal Storage	83%	71%	57%

Alternative	Description of Alternative	% Reduction Year 10 Average Conard's Branch Creek Chub	% Reduction Year 10 Average Richland Creek Creek Chub	% Reduction Year 10 Average Richland Creek Longear Sunfish
5	**Water Collection System Improvement + Sediment Cleanup to 1 ppm PCBs + 1000 gpm Treatment System**	86%	74%	60%
6	**Water Collection System Improvement + Sediment Cleanup to 1 ppm PCBs + 1000 gpm Treatment System + 2 Mgal Storage**	86%	75%	60%
7	**Water Collection System Improvement + Sediment Cleanup to 1 ppm PCBs + 500 gpm treatment System + 3 Settling Basins**	85%	74%	60%

PCB-contaminated sediment contributes approximately 27% of the PCBs in fish tissue within Conard's Branch; therefore, addressing PCB-contaminated sediment is critical to meeting the fish goals. Accordingly, U.S. EPA evaluated only leaving the sediment in place (No Action Alternative) and the removal of PCB-contaminated in-stream and bank sediment to 1 ppm PCBs on average, along with removal of floodplain soils to 5 ppm PCBs on average for Alternatives 3 through 7.

The estimated volume of PCB-contaminated sediment and soils is 1,141 cubic yards using the cleanup criteria for sediment, banks, and floodplain. CBS will take the excavated sediment and soils for off-site disposal in permitted landfills capable of accepting PCB-contaminated material. If PCB concentrations are less than or equal to 50 ppm PCBs, then the PCB-contaminated material will be disposed of in a special waste landfill. If sediments and soils are contaminated with concentrations of greater than 50 ppm PCBs, then a TSCA chemical waste landfill will be used for disposal. For costing purposes, U.S. EPA assumed that 100 tons of the sediments and soils are contaminated with greater than 50 ppm PCBs. Additional sampling to supplement historical sediment sampling data will be required prior to beginning the cleanup activities. It is estimated that remediation of the sediment, banks and floodplain soils will cost $1,184,109.

Below are descriptions of the Alternatives evaluated for the groundwater and sediment operable units. Costs are calculated using present worth, because this indicates how much money will need to be available today to completely fund the construction and operation and maintenance. To calculate the present worth, a 7% discount rate was used and a timeframe of 30 years of operation. The 30 years of operation and maintenance is used only for the purpose of estimating cost. The actual operation and maintenance period may be longer than 30 years or may be shorter.

Alternative 1: No Action (Shut Down the Current Water Treatment Plant)

Estimated Capital Cost: $0
Estimated Annual Operation and Maintenance: $0
Estimated Present Worth Cost: $0
Estimated Construction Timeframe: 0 months

The No Action Alternative is required to be evaluated pursuant to the National Contingency Plan 40 CFR 300(e)(6). In this alternative, the current treatment plant will be shut down and no further remedial activities will be implemented. The Capital Cost, Annual Operation and Maintenance Costs and Present Worth Costs are all $0.

Alternative 2: Continue to Operate the Current 500 gpm Water Treatment Plant

Estimated Capital Cost: $0
Estimated Annual Operation and Maintenance: $118,000
Estimated Present Worth Cost: $1,463,484
Estimated Construction Timeframe: 0 months

In this alternative, the current water treatment plant will continue to operate with no additional remedy components. The PCB-contaminated water is treated through the use of cartridge filters to remove suspended solids and carbon adsorption. The treatment plant (1) treats up to 500 gpm of water which is on average about 47% of the total spring flow and (2) captures about 38% of the PCB mass released. Fish remediation goals will not be met with this alternative.

Alternative 3: Continue to Operate the Current 500 gpm Water Treatment Plant with Improvement of Water Collection System and Sediment and Flood Plain Cleanup

Estimated Capital Cost: $1,305,513 ($1,184,109 for sediment operable unit and $121,404 for groundwater operable unit)
Estimated Annual Operation and Maintenance: $118,000
Estimated Present Worth Cost: $2,768,997
Estimated Construction Timeframe: 6 months

In this alternative, an improvement in the water collection system would be implemented to capture additional spring water for treatment by the current treatment system, which can treat up to 500 gpm. This improved collection system would be located farther downstream in Conard's Branch and would capture additional water near North Spring. To prevent water that has been treated by the treatment plant from being retreated, the discharge point for the treated water will also be moved farther downstream in Conard's Branch. A conceptual approach for improving the collection system and moving the effluent discharge point farther downstream in Conard's Branch is shown in Figure 12.

Sediment in Conard's Branch and within the banks would be remediated to 1 ppm PCBs on average and 5 ppm PCBs on average in the Conard's Branch floodplain. The total volume of sediment and soil to be excavated is estimated to be 1,141 cubic yards. Additional sampling will be required to fully define the contaminated areas. The excavated sediment and soils, if contaminated with concentrations of less than or equal to 50 ppm PCBs, will be disposed of off-site in a special waste landfill. If the sediments and soils are contaminated at levels greater than 50 ppm PCBs, then those sediments and soils will be disposed of off site in a chemical waste landfill. It is estimated that 100 tons of sediments and soils are greater than 50 ppm PCBs. The fish remediation goals will be met in 10 years for this alternative.

Alternative 4: Continue to Operate the Current 500 gpm Water Treatment Plant with Improvement of Water Collection System, Add Two Million Gallons of Stormwater Storage and Sediment and Flood Plain Cleanup

Estimated Capital Cost: $ 3,005,513
Estimated Annual Operation and Maintenance: $148,000
Estimated Present Worth Cost: $4,841,268
Estimated Construction Timeframe: 6 months

In this alternative, Alternative 3 would be implemented and two million gallons of stormwater storage would be added. The improvement in the collection system and additional stormwater storage would increase the percentage of spring flow treated to 59% with a 48% reduction in PCB mass. Sediment, bank soils, and floodplain soils in Conard's Branch would be remediated as described in Alternative 3. The fish remediation goals will be met in 10 years for this alternative.

Alternative 5: Expand the Current 500 gpm Water Treatment Plant to Treat 1,000 gpm with Improvement of Water Collection System and Sediment and Flood Plain Cleanup

Estimated Capital Cost: $2,500,323
Estimated Annual Operation and Maintenance: $138,000
Estimated Present Worth Cost: $4,211,987
Estimated Construction Timeframe: 6 months

In this alternative, the current water treatment plant which treats up to 500 gpm will be expanded to treat 1,000 gpm and the improvement to the collection system and relocation of the discharge point for the treated water farther downstream (as described in Alternative 3) will be implemented. The expansion of the water treatment plant to 1,000 gpm will treat 66% of the spring flow with a 50% reduction in PCB mass. Sediment, bank soils, and floodplain soils in Conard's Branch would be remediated as described in Alternative 3. The fish remediation goals will be met in 10 years for this alternative.

Alternative 6: Expand the Current 500 gpm Water Treatment Plant to Treat 1,000 gpm with Improvement of Water Collection System, the Addition of Two Million Gallons of Stormwater Storage and Sediment and Flood Plain Cleanup

Estimated Capital Cost: $4,200,323
Estimated Annual Operation and Maintenance: $168,000
Estimated Present Worth Cost: $6,284,259
Estimated Construction Timeframe: 6 months

In this alternative, Alternative 5 would be implemented and two million gallons of stormwater storage would be added to the 1,000 gpm system. The percentage of spring flow treated would be 74% and PCB mass would be reduced by 64%. Sediment, bank soils, and floodplain soils in Conard's Branch would be remediated as described in Alternative 3. The fish remediation goals will be met in 10 years for this alternative.

Alternative 7: Continue to Operate the 500 gpm Water Treatment Plant with Improvement of Water Collection and the Addition of Three Settling Basins in Series and Sediment and Flood Plain Cleanup

Estimated Capital Cost: $3,901,013
Estimated Annual Operation and Maintenance: $163,000
Estimated Present Worth Cost: $5,925,385
Estimated Construction Timeframe: 6 months

In this alternative, the water treatment plant which treats up to 500 gpm will continue to operate as described in Alternative 3, but a series of three settling ponds in series, for a total of 18-acres in size, will be installed to treat stormwater. With this Alternative, all the water would be treated to some degree and 75% of the PCB mass released would be captured and treated. Sediment, bank soils and floodplain soils in Conard's Branch would be remediated as described in Alternative 3. The fish remediation goals will be met in 10 years for this alternative.

Common Elements and Distinguishing Features of Each Alternative

Section 121(d) of CERCLA and the National Oil and Hazardous Substances Contingency Plan (NCP) Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4). All of the alternatives, except the "No Action" alternative, require compliance with ARARs, unless they are waived. The water and sediment operable units contemplated for the site are subject to two types of ARARs. First, action-specific ARARs set forth requirements on how certain actions must be performed at the site. Second, chemical-specific ARARs set forth numeric values or methodologies for the handling of certain hazardous substances. Each category of ARARs is discussed below.

a. Action Specific ARARs

1. NPDES Requirements

The current 500 gpm water treatment plant is regulated by the State of Indiana through a NPDES permit. The current permit uses a 1 ppb discharge criteria. The selection of a water operable unit remedial alternative will eliminate the NPDES permit, because on-site remedial actions are specifically exempt from such administrative requirements under Section 121(e) of CERCLA, 42 U.S.C. §96219(e). Therefore, new substantive discharge requirements will be developed for the water treatment plant. Nevertheless, certain regulations enacted by the State of Indiana under its federally-approved NPDES program are relevant and appropriate to discharges from the plant.

Specifically, the plant is subject to the following action-specific ARARs:

- Surface Water Quality Criteria for Specific Substances - 327 Indiana Administrative Code (IAC) 2-1-6, Table 1
- Conditions applicable to all permits - 327 IAC 5-2-8 (3), (7), (8), (9), (10), (11), (12), (13), (14)
- Considerations in the calculation and specification of effluent limitations - 327 IAC 5-2-11(a) (1), (2), (3), (4), (5)(C); (d), (e), (f), (g), (h)
- Establishment of water quality-based effluent limitations for dischargers not discharging water to within the Great Lakes system - 327 IAC 5-2-11.1(a), (b), (d), (f), (g), (h)
- Applicability of Best Management Practices - 327 IAC 5-9-2 (a), (c), (d), (e), (i), (j)
- Monitoring - 327 IAC 5-2-13 (a), (c), (d), (e), (f)

The Indiana Department of Environmental Management has stated in correspondence that it typically sets an effluent limit of 0.3 ppb for PCBs discharged by treatment plants into waters other than the Great Lakes System. Spring water up to 500 gpm from the Northwest Spring System will be captured and treated and will be subject to the 0.3 ppb PCB discharge criteria. IDEM has also stated that discharge criteria for constituents other than PCBs will not be required. According to the fate and transport model, spring water flows greater than 500 gpm are responsible for only 11% to 31% of the PCBs found in fish in Conard's Branch and Richland Creek. Further, and more importantly, it is not necessary to capture these flows for the remedy to be protective of human health and the environment. Rather, the fate and transport model shows that the capture and treatment of spring water during low flow conditions (i.e. flows less than 500 gpm) is enough to reduce PCBs in fish to the point where their consumption will no longer pose an unacceptably high risk to human health and the environment.

Under CERCLA Section 121(d)(4), U.S. EPA may select a remedial action that does not attain a level or standard of control at least equivalent to ARARs if U.S. EPA finds that compliance with such requirements is technically impracticable from an engineering perspective. As discussed previously, the U.S. EPA is implementing a TI waiver pursuant to CERCLA Section 121(d)(4)(C) for water that is not treated by the water treatment plant. Due to the large volume of stormwater produced from the karst geology, the ability to store and eventually treat all the stormwater is technically impracticable from an engineering standpoint. For example, during a 21-day period beginning on December 29, 2004, 61.4 million gallons of water, or 188-acre feet, bypassed the existing 500 gpm water treatment plant. Storing this large amount of water for eventual treatment would require over 100 storage tanks able to contain 600,000 gallons each, or a 47-acre storage lagoon 4 feet in depth.

The following ARARs will be waived for spring water flows in excess of 500 gpm that bypass the water treatment plant:

- 327 IAC 2-1-6 Table
- 327 IAC 5-2-8 (10), (11), (12), (13) (14)
- 327 IAC 5-2-11(a)(1), (2), (3), (4), (5)(C), (d), (e), (f), (g), (h)
- 327 IAC 5-2-11.1(a), (b), (d), (f), (g), (h)

As a result of this TI Waiver, no discharge criteria will be given to spring water not treated by the 500 gpm treatment plant.

2. Fugitive Dust Requirements

Under 326 IAC 6-4-2, the State of Indiana has promulgated emission limits for "fugitive dust," i.e., particulate matter that escapes beyond the boundaries of the site. These emission limits are relevant and appropriate with respect to dust resulting from the excavation of Conard's Branch sediment, bank and floodplain soils. Likewise, the emission limits are relevant and appropriate with respect to on-site construction for the water operable unit.

Under 326 IAC 6-4-4, the State of Indiana has prohibited any vehicle from driving on any public right-of-way unless the vehicle has been so constructed as to prevent its contents from escaping and forming fugitive dust. This requirement is relevant and appropriate not only with regard to the excavation of Conard's Branch sediment, bank and floodplain soils, but also for all the construction activities contemplated under the water operable unit.

b. Chemical-specific ARARs

1. 329 IAC 4.1-4 Requirements for storage and disposal of PCB wastes

Under 329 IAC 4.1-4, any sludge, soil, or other material generated by a water treatment facility or excavation of on-site material must be managed as PCB remediation waste in accordance with 40 CFR § 761.61. This requirement is relevant and appropriate with respect to PCB-contaminated soil/sediment generated by the excavation of Conard's Branch sediment, bank and floodplain soils or by the construction of the new water collection system and movement of the effluent line farther downstream of the site. Likewise, this requirement is relevant and appropriate with respect to PCB-contaminated sludge generated by the water treatment facility.

2. 329 IAC 3.1 Universal Waste Rule

Under 329 IAC 3.1, all wastes generated by remediation activities must be analyzed to determine whether they meet the characteristics of hazardous waste. If they meet these characteristics, then they must be disposed of in an approved RCRA-permitted facility in accordance with 40 C.F.R. §§ 260-280. This requirement is relevant and appropriate with respect to waste generated by the excavation of the Conard's Branch sediment, bank and floodplain soils or by the construction of the new water collection system and movement of the effluent line farther downstream of the site. Likewise, this requirement is relevant and appropriate with respect to PCB-contaminated sludge generated by the water treatment facility.

3. 329 IAC 10 Solid Waste Land Disposal Facilities

Under 329 IAC 10, all wastes determined to be non-hazardous must be disposed of in a facility permitted to accept such waste. This requirement is relevant and appropriate with respect to waste generated by the excavation of Conard's Branch sediment, bank and floodplain soils or by the construction of the new water collection system and movement of the effluent line farther downstream of the site. Likewise, this requirement is relevant and appropriate with respect to PCB-contaminated sludge generated by the water treatment facility.

4. 326 IAC 2-4.1 Major Sources of Hazardous Air Pollutants

Under 326 IAC 2-4.1, any owner or operator who constructs a major source of hazardous air pollutants (HAP) shall comply with the requirements of this section. PCBs are a HAP. Thus, this section is relevant and appropriate to the extent that the selected remedy would involve the construction of a major source of HAP. Under 40 C.F.R. § 63.41, the term "construct a major source" means to fabricate, install or erect a new process or production unit which emits or has the potential to emit 10 tons per year of any HAP. U.S. EPA does not anticipate that any of the proposed remedies would meet this threshold limit.

5. 326 IAC 2-5.1-3(a)(1)(D) Permits for New HAP Source

Under 326 IAC 2-5.1-3(a)(1)(D), a source of HAP that has the potential to emit ten tons per year of HAP must apply for a construction and operating permit. A source with lower emissions is exempt. To the extent that any of the proposed remedies would have the potential to emit ten tons per year of HAP, the remedy must comply with the substantive requirements of a permit, although no permit would be issued for the site.

6. 326 IAC 2-5.1-2(a)(1)(A) Registrations

Under 326 IAC 2-5.1-2(a)(A), a source of HAP that has the potential to produce twenty-five tons per year and equal to or greater than five tons per year of either particulate matter or particulate matter less than 10 microns in size, must apply for a registration. A source with emissions lower than five tons per year is exempt. To the extent that any of the proposed remedies have the potential to meet or exceed this threshold limit of five tons per year, the remedy must comply within the substantive requirements of the registration rule, although registration will not be required for the site. U.S. EPA does not anticipate that any of the proposed remedies will meet this threshold.

c. Use Restrictions

The Alternatives (except the No Action Alternative) share common elements, including the requirement of use or access restrictions. Use or access restrictions will be implemented through institutional controls. Institutional controls are administrative or legal constraints that minimize the potential for exposure to contamination by limiting land or resource use. Specific actions taken at sites to restrict access or use could include: Governmental Controls – such as zoning restrictions or ordinances; Proprietary controls – such as easements or covenants; Enforcement Tools – such as consent decrees or administrative orders; and Informational Devices – such as deed notices or state registries.

Several types of access or use restrictions employed simultaneously can increase the effectiveness of institutional controls. The following is a list of institutional controls that will be implemented:

- Residential and commercial development will be prohibited within the fence line surrounding the 10-acre landfill to prevent damage to the landfill cap and to the landfill gas vents.
- The southeast portion of the former landfill was remediated to industrial PCB standards and residential development in this southeast portion will be prohibited.
- Residential development and certain farming activities, such as grazing, within the floodplain area of Conard's Branch will be prohibited.
- Groundwater use will be prohibited at the landfill.

d. Operation and Maintenance

Each of the Alternatives (except the No Action Alternative) requires a program of Operation, Monitoring and Maintenance, and this will include routine inspection. It is anticipated that institutional controls will be relatively simple to develop, likely through a layered approach. Institutional controls may include proprietary controls (easements and/or covenants); deed restrictions; and enforcement tools (Administrative Orders on Consent and/or Consent Decrees), which will ensure the long-term reliability of the controls.

Expected Outcome of Each Alternative

U.S. EPA expects that Alternatives 3 through 7 will meet the fish remediation goals within 10 years or less based upon the fate and transport model. A long-term monitoring program will be implemented by CBS, which will verify if the fish remediation goals will be met. With the completion of the source control operable unit, industrial/commercial development may occur outside the landfill fence line. If the Sycamore Land Trust accepts the property, future development of the property would be unlikely.

COMPARATIVE ANALYSIS OF ALTERNATIVES

The U.S. EPA is required by CERCLA and the NCP to use nine criteria to evaluate the remedial alternatives against each other to determine the most appropriate remedy for the site. The nine criteria fall into three groups: threshold criteria, primary balancing criteria and modifying criteria. A description of the three criteria groups includes the following:

- Threshold criteria are requirements that each alternative must meet in order to be eligible for selection.
- Primary balancing criteria are used to weigh major trade-offs among alternatives.
- Modifying criteria are considered after public comment is complete and are of equal importance to the balancing criteria.

Each alternative is compared to the other to determine which alternative is the best balance of the nine criteria. The discussion below is a description of comparative analysis, and Table 9 provides a summary of the comparison.

Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is a threshold criterion and addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1 is not protective because the fate and transport model shows that if the current water treatment plant was shut down, PCB levels in fish would increase by as much as four times the current levels. Likewise, Alternative 2 is not protective because the fate and transport model shows that PCB concentrations in fish tissue would never achieve the PCB goals for abating risks to humans and animals from the consumption of contaminated fish. CERCLA requires the selection of a remedy that is protective of human health and the environment. Consequently, neither Alternative 1 nor Alternative 2 meet this requirement and will be eliminated from any further consideration.

The remaining five alternatives (i.e. Alternatives 3 through 7) are protective of human health and the environment because the fate and transport model shows that fish remediation goals will be achieved within 10 years or less after completion of any one of these remedies. Comparing Alternatives 3, 4, 5, 6, and 7 against each other based upon the reduction of PCB levels in fish shows only slight differences among the Alternatives.

In the sediment operable unit, the remediation of the Conard's Branch sediment and bank soils to a 1 ppm PCB standard on average and 5 ppm PCBs on average for the floodplain soils will be protective of human health and the environment. Sediment contributes 27% of the PCBs found in fish tissue in Conard's Branch. According to the fate and transport model, PCB concentrations in fish will achieve U.S. EPA's goals within ten years or less if sediment in Conard's Branch is cleaned up and maintained at a concentration of 1 ppm or less. Since Richland Creek sediment contamination is under 1 ppm PCBs, a sediment cleanup is not required there.

Compliance with Applicable or Relevant and Appropriate Requirements

Compliance with ARARs is a threshold criterion, unless a waiver is implemented.

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of state or federal law, or alternatively, whether there is a basis for invoking a waiver of the ARAR. The water operable unit remedial alternatives require the improvement of the collection system and the operation of an on-site water treatment plant. This plant will not need to obtain a NPDES permit because on-site remedial actions are specifically exempt from such administrative requirements under Section 121(e) of CERCLA, 42 U.S.C. 96219(e). Nevertheless, certain regulations enacted by the State of Indiana under its federally-approved NPDES program are relevant and appropriate to discharges from the plant. In the Common Elements and Distinguishing Features of Each Alternative section, the ARARs that are required to be met are listed. In addition, U.S. EPA is implementing a TI waiver pursuant to CERCLA Section 121(d)(4)(C) for certain ARARs that would otherwise apply to water that is not treated by the 500 gpm treatment plant. Due to the difficulty in storing a very large volume of stormwater and the timeframe required to treat stormwater, a TI waiver from an engineering perspective is justified. It is technically impracticable from an engineering standpoint to have to construct 102 storage tanks or a 47-acre lagoon, four feet in depth, to treat the large volume of stormwater produced from the Northwest Spring system. The following ARARs will be waived for water not treated within the 500 gpm treatment plant:

- 327 IAC 2-1-6 Table 1
- 327 IAC 5-2-8 (10), (11), (12), (13) (14)
- 327 IAC 5-2-11 (a)(1), (2), (3), (4), (5)(C), (d), (e), (f), (g), (h)
- 327 IAC 5-2-11.1 (a), (b), (d), (f), (g), (h)

As result of this TI waiver, no discharge criteria will be given to spring water that is not treated by the 500 gpm treatment plant.

All ARARs will be met, excluding the ARARs associated with the TI waiver.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is a balancing criterion and refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk, if any, that will remain onsite following remediation and the adequacy and reliability of controls to mitigate these risks.

All of the remedial alternatives remaining under consideration will provide long-term protection of human health and the environment. As discussed above, the fate and transport model shows that the two primary contributors of PCBs in fish tissue in Conard's Branch and Richland Creek are (1) PCBs released during low-flow conditions and (2) PCBs in the sediment and banks of Conard's Branch. To address the first problem, each of the remedies will limit releases of PCBs into these streams at concentrations greater than 0.3 ppb until such time that the influent into the water treatment plant is equal to or less than 0.3 ppb. Further, to address the second problem, each of the remedies will require the removal of PCB-contaminated sediment in Conard's Branch with a concentration greater than 1 ppm and will require the removal of PCB-contaminated soil in the floodplain of Conards' Branch with a concentration greater than 5 ppm. After the remedy is completed, PCB concentrations should not only achieve target levels for fish tissue within ten years, but should also continue to meet these target levels in perpetuity.

Since it is not technically feasible to capture and treat all PCBs released from the Site, there is a risk associated with all the remedies that the sediment in Conard's Branch could become recontaminated as a result of PCBs that bypass the treatment facility. The degree of this risk differs among the remedial alternatives depending upon the degree of mass reduction achieved by the remedy. For instance, Alternative 7 poses the lowest risk of recontamination because it will achieve the greatest mass reduction in comparison to the other alternatives. Regardless of the remedy selected, U.S. EPA intends to establish operation and maintenance requirements specifying that PCB concentrations in sediment must be maintained at a level that prevents recontamination of fish. Thus, all of the remedies should continue to maintain reliable protection of human health and the environment even if recontamination of the sediment should occur.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment is a balancing criterion and refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

All the remedial alternatives under consideration require the continued operation of the water treatment plant using the cartridge filters and carbon adsorption system to remove PCBs from spring water. Further, they all require that soil and sediment removed from Conard's Branch with a concentration greater than 50 ppm will be disposed of off-site in a landfill permitted to accept such PCB waste. Soil and sediment with PCB concentrations less than or equal to 50 ppm will also be disposed of off-site in a permitted special waste landfill. The off-site disposal will not reduce the toxicity, mobility or volume through treatment since no treatment will occur at the landfill. Treatment was not considered based upon the small volume of material and past activities implemented for contaminated soil and sediment at the other Bloomington PCB sites.

Despite the above similarities, the remedial alternatives differ significantly in terms of mass reduction. Alternative 7, which includes the construction of settling lagoons, will achieve the greatest reduction in the mass of PCBs released into Conard's Branch, reducing current releases by 64%. In contrast, Alternative 3, which expands the collection system for the existing treatment plant, will achieve the lowest reduction in mass of PCBs released in Conard's Branch, reducing current releases by 39%. However, as discussed previously, the fate and transport model does not show that removing the most mass will have a large impact on PCB levels in fish tissue, and therefore, it does not have a large impact on the protectiveness of the remedy. Accordingly, PCB mass reduction is not a factor that has been weighted heavily in U.S. EPA's remedy selection.

Short-Term Effectiveness

Short-term effectiveness is a balancing criterion and addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

All five alternatives that are protective for the water operable unit can be implemented. Standard construction methods can be used and the short-term risk to construction workers and potential contact with contaminated soils and groundwater will be eliminated through engineering controls and the implementation of health and safety protocols. The excavation of sediment and soils from Conard's Branch and the floodplain area will be monitored to ensure that the surrounding community and workers are protected from PCBs that may be present either through fugitive dust or volatilization. Increased truck traffic may occur in the area for the transport of contaminated sediment and similar precautions used during the source control operable unit will be implemented.

Implementability

Implementability is a balancing criterion and addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

The five protective alternatives for the water operable unit can all be implemented. The ability to store two million gallons of stormwater as described in Alternative 4 and Alternative 6 along with constructing settling basins as described in Alternative 7 is feasible. The necessary construction equipment is available and operating the technology is common practice. The proposed excavation activities also can be implemented and will not pose unacceptable problems or risks.

Cost

Cost is a balancing criterion and to calculate the cost for each alternative, a 7% discount rate was used and net present value costs were completed. Total net present value costs and assumed operation and maintenance costs for both the water and sediment operable units are described in Table 9.

State/Support Agency Acceptance

State and support agency acceptance is a modifying criterion. The State of Indiana, along with the City of Bloomington and Monroe County, support the implementation of Alternative 3.

Community Acceptance

Community acceptance is a modifying criterion. The public comments are addressed in the attached Responsiveness Summary. A citizens group that is in litigation against U.S. EPA submitted comments opposing Alternative 3 and recommending complete excavation of the landfill. CBS Corporation submitted a large amount of comments stating the risk assessments have overestimated the risk and that no further action would be a more appropriate remedy.

PRINCIPAL THREAT WASTES

The NCP establishes an expectation that U.S. EPA will use treatment to address the principal threats posed by a site whenever practicable (NCP 300.430(a)(1)(iii)(A). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

The principal threat waste was addressed in the 1999 source control operable unit. The conduit and cave investigation did not produce evidence of dense non-aqueous phase liquids or high concentrations of PCBs as principal threat wastes. Additional evidence of the lack of high concentrations of PCBs as principal threat waste was through the analysis of the spring flow data. Analysis of the sampling data shows a 6% yearly decrease in PCB concentrations in South Spring since the completion of the source control operable unit. The groundwater treatment alternatives will address the non-principal threat waste.

SELECTED REMEDY

U.S. EPA selects Alternative 3 (sediment cleanup/collection system improvements and operation of the water treatment plant which treats up to 500 gpm) for both the water and sediment operable units. This alternative was selected over the other alternatives because it is expected to achieve substantial and long-term risk reduction through the removal of sediment and improvements in the water collection system during low-flow conditions. The fate and transport model shows that the improvement of the water collection system to capture the North Spring bypass water, along with completing the sediment removal and continuing to run the water treatment plant over time, will reduce PCB levels in fish tissue to acceptable levels based upon the fate and transport model. Other remedial alternatives remove greater PCB mass than Alternative 3, but PCB mass does not produce a large increased reduction in PCB concentrations in fish. This is because most of the PCBs in fish are attributable to the low volumes of PCBs released during periods of low flow. The fate and transport model shows that fish accumulate PCBs primarily during low-flow conditions in the summer months when the fish are growing. Short-term exposures to PCBs released during storm events do not have a significant impact upon PCB concentrations in fish, even though the mass of PCBs released during storm events is much higher than the mass released during low-flow events. Therefore, implementing Alternative 3 will meet the remediation goals and is cost effective compared with the other alternatives. The capital cost for Alternative 3 is $1,305,513 ($1,184,109 for the sediment portion), annual operation and maintenance costs are $118,000, and the total present worth costs over 30 years is $2,768,997.

With Alternative 3, the treatment plant will continue to operate until water from the Northwest Spring System is less than 0.3 ppb PCBs for a 12-month period. An alternative shut-off criteria may be proposed, and if U.S. EPA determines that the alternative shut-off criteria provides a standard that is protective of human health and the environment, then the shut-off criteria identified in this ROD Amendment may be modified consistent with the substantive and procedural requirements of CERCLA and the NCP.

The fate and transport model predicts that PCB levels in fish will be reduced to acceptable levels within 10 years through the implementation of Alternative 3. To verify if the predictions in the model are correct, a long-term monitoring program will be developed and implemented to monitor the site remedy. If the remedy is not functioning as planned, a special remedy reopener will be used and additional investigation and additional remediation may be required to ensure that the remedy is protective of human health and the environment. Further, as mentioned above, the operation and maintenance requirements for the remedy will specify that PCB concentrations in sediment must be maintained at a level that prevents recontamination of fish tissue after the goals for fish tissue concentration have been achieved.

STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, U.S. EPA must select remedies that are (1) protective of human health and the environment, (2) comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), (3) are cost-effective, and (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy, Alternative 3, will protect human health and the environment through removing contaminated sediment from Conard's Branch, improvement in the spring water collection system and the continued operation of the 500 gpm water treatment plant. The human health fish remediation goals of 0.2 ppm PCBs in fillets within Richland Creek and the ecological fish remediation goals of 1.8 to 2.3 ppm PCBs on average in whole fish within Conard's Branch and 0.7 to 0.9 ppm PCBs on average in whole fish within Richland Creek will be met within 10 years after completion of construction of the selected remedy. There are no short-term threats associated with the Selected Remedy that cannot be readily controlled and no cross media impacts are expected from the Selected Remedy.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy for the groundwater and sediment operable units will meet the respective ARARs and a TI Waiver has been granted for water not treated by the 500 gpm water treatment plant.

The following is a list of action specific ARARs for the Selected Remedy:

The current 500 gpm water treatment plant is regulated by the State of Indiana through a NPDES permit. The current permit uses a 1 ppb PCB discharge criteria. Based upon discussions with the State, the selection of a water operable unit remedial alternative will eliminate the NPDES permit, because on-site remedial actions are specifically exempt from such administrative requirements under Section 121(e) of CERCLA, 42 U.S.C. §96219(e). Therefore, new substantive discharge requirements will be developed for the water treatment plant. Nevertheless, certain regulations enacted by the State of Indiana under its federally-approved NPDES program are relevant and appropriate to discharges from the plant.

Specifically, the plant is subject to the following action-specific ARARs:

- Surface Water Quality Criteria for Specific Substances - 327 IAC 2-1-6, Table 1

- Conditions applicable to all permits - 327 IAC 5-2-8 (3), (7), (8), (9), (10), (11), (12), (13), (14)

- Considerations in the calculation and specification of effluent limitations - 327 IAC 5-2-11(a) (1), (2), (3), (4), (5)(C); (d), (e), (f), (g), (h)

- Establishment of water quality-based effluent limitations for dischargers not discharging water to within the Great Lakes system - 327 IAC 5-2-11.1(a), (b), (d), (f), (g), (h)

- Applicability of Best Management Practices - 327 IAC 5-9-2 (a), (c), (d), (e), (i), (j)

- Monitoring - 327 IAC 5-2-13 (a), (c), (d), (e), (f)

The State of Indiana typically sets an effluent limit of 0.3 ppb for PCBs discharged by treatment plants into waters other than the Great Lakes System. Spring water up to 500 gpm from the Northwest Spring System will be captured and treated and will be subject to the 0.3 ppb discharge criterion. Based on the fate and transport model, it is not necessary to capture and treat more water because the additional water does not pose an unacceptable risk to human health and the environment.

Under CERCLA Section 121(d)(4), U.S. EPA may select a remedial action that does not attain a level or standard of control at least equivalent to ARARs if U.S. EPA finds that compliance with such requirements is technically impracticable from an engineering perspective. As discussed below, the U.S. EPA is implementing a TI waiver pursuant to CERCLA Section 121(d)(4)(C) for water that is not treated by the water treatment plant. Due to the large volume of stormwater produced from the karst geology, the ability to store and eventually treat all the stormwater is technically impracticable from an engineering standpoint. For example, during a 21-day period beginning on December 29, 2004, 61.4 million gallons of water, or 188-acre feet, bypassed the 500 gpm water treatment plant. Storing this large amount of water for eventual treatment would require over 100 storage tanks able to contain 600,000 gallons each, or a 47-acre storage lagoon 4 feet in depth.

The following ARARs will be waived for water not treated within the water treatment plant:

- 327 IAC 2-1-6 Table 1

- 327 IAC 5-2-8 (10), (11), (12), (13) (14)

- 327 IAC 5-2-11(a)(1), (2), (3), (4), (5)(C), (d), (e), (f), (g), (h)

- 327 IAC 5-2-11.1(a), (b), (d), (f), (g), (h)

As a result of this TI Waiver, no discharge criteria will be given to spring water not treated by the 500 gpm treatment plant.

Additional action specific ARARs associated with fugitive dust control are as follows:

- 326 IAC 6-4-2

- 326 IAC 6-4-4

The following is a list of chemical specific ARARs for the Selected Remedy:

- 329 IAC 4.1-4 Requirements for Storage and Disposal of PCBs
- 329 IAC 3.1 Universal Waste Rule
- 329 IAC 10 Solid Waste Land Disposal Facilities
- 326 IAC 2-4.1 Major Sources of Hazardous Air Pollutants
- 326 IAC 2-5.1-3(a)(1)(D) Permits for New Hazardous Air Pollutants
- 326 IAC 2-5.1-2(a)(1)(A) Registrations

Cost Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money spent. In making this determination, the following definition was used. "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP 300.430.(f)(1)(ii)(D)). This was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

The capital cost for Alternative 3 is $1,305,513 with operation and maintenance expected to cost $118,000 per year. Calculating a net present value using a 7% discount rate shows a total cost of $2,768,997. The cost of the sediment operable unit alone is $1,184,109.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

U.S. EPA has determined that the Selected Remedy for the groundwater and sediment operable units represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, U.S. EPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element, and bias against off-site treatment and disposal, and considering State and community acceptance.

The Selected Remedy treats PCB- contaminated spring water prior to discharge to Conard's Branch, which flows into Richland Creek. The Selected Remedy satisfies the criteria for long-term effectiveness through the collection and treatment of spring water. The Selected Remedy does not present short-term risks and the technology to implement the remedy is not unusual. The remediation of soils/sediment at Conard's Branch does not utilize permanent solutions and alternative treatment technologies for the estimated 1,141 cubic yards, but it is consistent with previous PCB cleanups in which off-site disposal was utilized.

State/Support Agency Acceptance

The State of Indiana, the City of Bloomington, and Monroe County all support the implementation of Alternative 3.

Community Acceptance

Community acceptance is an important part of the remedy selection process and was assessed during the public comment period and associated public participation activities. Community acceptance of the preferred alternative identified in the Proposed Plan for the ROD Amendment was fully evaluated at the conclusion of the public comment period. The public comments are addressed in the attached Responsiveness Summary.

Preference for Treatment as a Principal Element

By continuing to treat spring flow less than 500 gpm, improve the collection system, and complete the sediment operable unit, the Selected Remedy addresses the remaining threats posed at the site through the use of treatment technologies. By utilizing the necessary treatment for the groundwater operable unit, the statutory reference for remedies that employ treatment as a principal element is satisfied. Treatment is not employed for the sediment operable unit, but the remedy is consistent with the other soil/sediment cleanups completed in Bloomington and the surrounding area.

Five-Year Review Requirements

Because the site remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a policy review will be conducted.

DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

The Proposed Plan for Operable Units 2 and 3 was released for public comment on July 6, 2007. The Proposed Plan identified Alternative 3 as the Preferred Alternative for addressing the continuing release of PCBs from springs into Conard's Branch and Richland Creek and a proposed soil/sediment cleanup in and near Conard's Branch. U.S. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy as originally identified in the Proposed Plan were necessary or appropriate.

Table 9
Comparative Analysis of Remedial Alternatives

Criteria	Alternative 1: No Action	Alternative 2: 500 gpm Treatment System	Alternative 3:Source Control + 500 gpm Treatment System	Alternative 4: Source Control + 500 gpm Treatment System + 2 Mgal Storage	Alternative 5: Source Control + 1000 gpm Treatment System	Alternative 6: Source Control + 1000 gpm Treatment System + 2 Mgal Storage	Alternative 7: Source Control + 500 gpm Treatment System + 3 Settling Basins
HUMAN HEALTH & THE ENVIRONMENT	(-) Does Not Meet/(+) Meets						
Protection of Human Health	-	-	+	+	+	+	+
Ecological Protection	-	-	+	+	+	+	+
COMPLIANCE WITH ARARs	(-) Does Not Meet/(+) Meets						
Chemical-Specific ARARs	-	+	+	+	+	+	+
Location-Specific ARARs	-	+	+	+	+	+	+
Action-Specific ARARs	-	+	+	+	+	+	+
Other Criteria, Advisories, Guidance	-	+	+	+	+	+	+
LONG-TERM EFFECTIVENESS AND PERMANENCE	(+) = Increasing Effectiveness = (++++)						
Magnitude of Residual Risk - Human	+	++++	++++	++++	++++	++++	++++
Magnitude of Residual Risk - Ecologi	+	++++	++++	++++	++++	++++	++++
Adequacy and Reliability of Controls	+	++++	++++	++++	++++	++++	++++
MOBILITY AND VOLUME THROUGH TREATMENT	(+) = Greater Reduction = (++++)						
Treatment/Recycling Processes Utiliz	-	+	++	++	+++	+++	++++
Amount of Hazardous Materials Dest	-	+	++	++	+++	+++	++++
Degree of Expected Reductions in To	-	+	++	++	+++	+++	++++
Irreversibility	-	+	++	++	+++	+++	++++
Type and Quantity of [Process] Resid	-	+	++	++	+++	+++	++++
SHORT-TERM EFFECTIVENESS	(+) = Increasing Effectiveness = (++++)						
Protection of Community and Worker	+	++++	+++	+++	+++	+++	+++
Environmental Impacts	+	++++	+++	+++	+++	+++	+++
Time Until Remedial Action Objective	+	++++	+++	+++	+++	+++	+++
IMPLEMENTABILITY	(+) = Increasing Potential = (++++)						
Ability to Construct and Operate the T	++++	++++	++++	++++	++++	++++	+++
Reliability of the Technology	++++	+++	++++	+++	++++	++++	+++
Ease of Undertaking Additional Reme	++++	+++	++++	++	++++	++++	++++
Ability to Monitor Effectiveness of the	++++	+++	++++	++	++++	++++	++++
Ability to Obtain Approvals from Othe	+	++	++++	++	++++	++++	++
Coordination with Other Agencies	+	++	++++	++++	++++	++++	++++
Availability of Off-Site Treatment, Sto	++++	++++	++++	++++	++++	++++	++++
Availability of Necessary Equipment a	++++	++++	++++	++++	++++	++++	+++
Availability of Prospective Technologi	++++	++++	++++	++++	++++	++++	++++
COST	Comparative Cost (without Mod A & B)						
Capital	$0	$0	$1,305,513	$3,005,513	$2,500,513	$4,200,323	$3,901,013
O&M	$0	$1,463,484	$1,463,484	$1,835,755	$1,711,665	$2,083,936	$2,024,373
Present Worth	$0	$1,463,484	$2,768,997	$4,841,268	$4,211,987	$6,284,259	$5,925,385